CLIMATE AND POLLUTION AGENCY

Greenhouse Gas Emissions 1990-2011

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Annexes to National Inventory Report

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Annex I - XII

National Inventory Report 2013 – Norway

Annex I:	Key categories
Annex II:	Uncertainties in the Norwegian Greenhouse Gas Emission Inventory
Annex III:	Energy Balance Sheets 1990 - 2011
Annex IV:	CO_2 capture and storage at petroleum production fields – storage site characteristics and monitoring methodology
Annex V:	National Greenhouse Gas Inventory System in Norway
Annex VI:	Summary II report for CO_2 equivalent emissions 1990-2011
Annex VII:	Harvested wood products
Annex VIII:	SEF and Registry Changes
Annex IX:	QA/QC of point sources
Annex X:	Agriculture
Annex XI:	Quantification of differences between RA and SA
Annex XII:	Statistical differences in the RA and SA

Annex I: Key Categories

This chapter outlines the Tier 2 methodologies used to find which sources are key categories in the Norwegian greenhouse gas emission inventory.

Two different methods are used for the key category analysis. First, the standard method as described in IPCC Good Practice Guidance (IPCC 2001) is used, both at the Tier 1 level and at the Tier 2 level with uncertainties. Second, a sensitivity analysis may be performed using the specification of the model for the uncertainty analysis, as described in Rypdal and Zhang (2000). The uncertainty model is presented in Annex II. The discussion focuses primarily on the standard method. The sensitivity analysis has not been repeated since the 2000 report.

Key categories are identified as the emission sources that add up to 90 per cent of total uncertainty in level and/or trend. This definition of a key category is according to IPCC Good Practice Guidance (IPCC 2000) which is based on Statistics Norway (2001e). A Tier 2 analysis for the LULUCF sector has also been performed. However, key categories for non-LULUCF sources are based on the analysis without LULUCF.

The key category analysis is performed at the level of IPCC source categories and each GHG from each source category is considered separately with respect to total GWP weighted emissions (HFCs and PFCs are grouped together). The advantage in using a Tier 2 rather than the Tier 1 methodology is that uncertainties are taken into account so the ranking shows where uncertainties can be reduced.

The first step taken to find key categories with respect to level and trend was the determination of uncertainties in input parameters (AD = activity data and EF = emission factors). Uncertainties of activity data and emissions factors were combined to source uncertainty by the error propagation rule $U_{source} = \sqrt{U_{AD}^2 + U_{EF}^2}$ (IPCC 2001, equation 6.4).

The next step was the use of sensitivity analysis to identify the parameters in the inventory that most influence the total GHG emissions in level and in trend. The standard method does not take into account correlations. This has partly been handled by aggregating sources with the same emission factors. However, sources with similar emission factors in stationary combustion, categories 1A1, 1A2, and 1A4, were treated separately as suggested in the 2006 IPCC guidelines. Also, correlations due to common activity data for several pollutants have not been taken into account. This may lead to an underestimation of the uncertainty importance for such sources. In a sensitivity analysis (Rypdal and Zhang 2000), such correlations may be specified in the model. The sensitivity analysis also allows separate treatment of activity data and emission factors.

Compilations of the uncertainty importance elasticity lead to the estimation of uncertainty importance of each input parameter with respect to total level and trend uncertainty. From this we get a ranked list of parameters which add up to 90 per cent of total uncertainty in level and trend. The LULUCF key categories come in addition to this.

A summary of the key categories is given in Table AI-2 for the emissions categories, and a summary for removal key categories is given in Table AI-3. The result in level and trend from the Tier 1 analysis for emissions sources is given in Table AI-1.

According to IPCC (2001) it is good practice to give the results at the Tier 2 level if available. However, in the 2006 IPCC guidelines it is suggested that good practice reporting should include key

categories from both the Tier 1 and Tier 2 analyses. The sources listed in Table AI-1 were key categories according to the Tier 1 analysis but not according to the Tier 2 analysis. All these sources were key categories at Tier 1 also in the 2012 NIR.

Table AI-1. Summary of identified key categories only in the Tier 1 analysis.

	Source category	Gas	Level assessment Tier 1 1990	Level assessment Tier 1 2011	Trend assessment Tier 1 1990-2011
2A1	Cement Production	CO_2	**1.26**	**1.40**	0.33
2B5	Other Chemical Industry	CO_2	**0.57**	**0.80**	**0.52**
2B1	Ammonia Production	CO_2	**0.99**	**0.61**	**0.89**
4B	Manure Management	CH_4	**0.59**	**0.58**	0.02
2A2	Lime Production	CO_2	0.10	**0.42**	**0.74**
1A5b	Military - Mobile	CO_2	**0.78**	0.40	**0.89**
2C4	SF_6 Used in Aluminium and Magnesium Foundries	SF_6	**4.26**	.	.

Bold figures indicate whether the source category is a key.

CH_4 from coal mining - 1B1a - has been designated key in the previous National Inventory Reports. This source is not identified by the quantitative method. It is included because the national emission factor we use is in an order of magnitude less than IPCC's default factors (not shown in the tables). CO_2 from clinker production - 2A1 – and from ammonia production – 2B1 – and capture and storage of CO_2 at the Sleipner oil field are all defined as key categories based on qualitative criteria.

The analyses have been performed for 1990 and 2011 GHG emission data. The main conclusion is that there are few differences in the result for 1990 compared with 2011.

For the *Land use, Land-use Change and Forestry (LULUCF)* sector, Table AI-3 shows the results of the Tier 2 key category analysis performed as described in IPCC (2003) . Uncertainties of land use category area and C change estimates are based on standard sampling methodology as detailed in chapters 7.2.3 and 7.2.4. All key categories identified using the Tier 2 method were also identified using the Tier 1 method. In both, Tier 1 and Tier 2 analyses, all three C pools (living biomass, soil and dead organic matter) in the forest land remaining forest land category are among the top key categories.

Table AI-2. Summary of identified emission key categories. Excluding LULUCF.

	Source category	Gas	Level assessment Tier 2 1990	Level assessment Tier 2 2011	Trend assessment Tier 2 1990-2011	Method (Tier) 2011
Tier 2 key categories (large contribution to the total inventory uncertainty)						
4D1	Direct soil emissions	N_2O	**27.16**	**22.70**	**11.15**	Tier 1a
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous Fuels	CO_2	**4.32**	**9.50**	**12.57**	Tier 2
4D3	Indirect emissions	N_2O	**6.74**	**6.13**	**1.56**	Tier 2
1A3b	Road Transportation	CO_2	**4.59**	**5.70**	**2.63**	Tier 1a
4A	Enteric Fermentation	CH_4	**6.10**	**5.05**	**2.62**	Tier 1/2*
2F	Consumption of Halocarbons and Sulphur Hexafluoride	HFCs	0.00	**4.65**	**11.33**	Tier 2
1B2a	Oil (incl. oil refineries, gasoline distribution)	CO_2	**4.75**	**4.18**	**1.44**	Tier 2
1A3d	Navigation	CO_2	**3.54**	**3.98**	**1.03**	Tier 2
6A	Solid Waste Disposal on Land	CH_4	**6.42**	**3.78**	**6.48**	Tier 2
1A3e	Other (snow scooters, boats, motorized equipment)	CO_2	**1.59**	**3.25**	**4.04**	Tier 2
1A3a	Civil Aviation	CO_2	**1.42**	**2.38**	**2.32**	Tier 2
1B2c	Venting and Flaring	CH_4	**1.14**	**2.35**	**2.94**	Tier 2
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Liquid Fuels	CO_2	**2.81**	**2.18**	**1.57**	Tier 2
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Other Fuels	CO_2	0.31	**1.88**	**3.82**	Tier 2
1A4	Other sectors - Mobile Fuel Combustion	CO_2	**1.98**	**1.88**	0.26	Tier 2
1A3e	Other (snow scooters, boats, motorized equipment)	N_2O	0.73	**1.79**	**2.59**	Tier 1a
2C3	Aluminium Production	CO_2	**1.53**	**1.72**	0.44	Tier 2
1B2c	Venting and Flaring	CO_2	**1.67**	**1.63**	0.11	Tier 2
4D2	Animal production	N_2O	**1.89**	**1.59**	**0.76**	Tier 2
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Biomass	CH_4	**0.96**	**1.16**	0.49	Tier 1
4B	Manure Management	N_2O	**1.20**	**1.11**	0.23	Tier 2
6B	Wastewater Handling	N_2O	**0.90**	**1.01**	0.27	Tier 1

1B2a	Oil (incl. oil refineries, gasoline distribution)	CH_4	0.68	**0.81**	0.30	Tier 2
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Solid Fuels	CO_2	**0.90**	0.77	0.33	Tier 2
2C2	Ferroalloys Production	CO_2	**0.79**	0.66	0.32	Tier 2
1A3d	Navigation	CH_4	0.03	0.46	**1.05**	Tier 2
2C3	Aluminium Production	PFCs	**7.04**	0.45	**16.13**	Tier 2
1B2b	Natural Gas	CH_4	0.02	0.34	**0.77**	Tier 2
2B2	Nitric Acid Production	N_2O	**1.28**	0.17	**2.72**	Tier 2
2B4	Carbide Production	CO_2	0.43	0.07	**0.88**	Tier 2
Tier 1 key categories (large contribution to the total emissions)						
4B	Manure Management	CH_4	0.79	0.78	0.03	Tier 2
2B5	Other Chemical Industry	CO_2	0.27	0.38	0.26	Tier 2
2B1	Ammonia Production	CO_2	0.39	0.24	0.38	Tier 2
1A5b	Military - Mobile	CO_2	0.29	0.15	0.35	Tier 2
2A1	Cement Production	CO_2	0.05	0.05	0.01	Tier 2
2A2	Lime Production	CO_2	0.00	0.01	0.02	Tier 2
2C4	SF_6 Used in Aluminium and Magnesium Foundries	SF_6	0.06	.	.	Tier 2
Qualitative key categories						
1B1a	Coal Mining and Handling	CH_4	0.43	0.22	0.53	Tier 2
	Capture and storage	CO_2				CS (Tier 2)

Bold figures indicate whether the source category is key in the tier 2 analysis.

Table AI-3. Summary of identified LULUCF key categories.

	Source category	**Gas**	**Level assessment Tier 2 1990**	**Level assessment Tier 2 2011**	**Trend assessment Tier 2 1990-2011**	**Method (Tier) 2011**
Tier 2 key categories (large contribution to the total inventory uncertainty)						
5A1	Forest Land remaining Forest Land, Forest inventory area, Living Biomass	CO_2	**12.13**	**20.38**	**28.56**	Tier 3

5A1	Forest Land remaining Forest Land, Forest inventory area, Soils, Organic	CO_2	**19.90**	**16.66**	**10.78**	Tier 2
5A1	Forest Land remaining Forest Land, Forest inventory area, Dead organic matter	CO_2	**13.05**	**7.57**	0.15	Tier 3
5E2	Land converted to Settlements, Soils	CO_2	**0.29**	**6.58**	**13.79**	Tier 3
5B1	Cropland remaining Cropland, Arable, Soils (organic)	CO_2	**9.13**	**6.02**	**1.45**	Tier 2
5A2	Land converted to Forest Land, Soils, Mineral	CO_2	**0.05**	**1.44**	**3.05**	Tier 1
5A2	Land converted to Forest Land, Living biomass	CO_2	**0.35**	**0.86**	**1.41**	Tier 3
5E2	Land converted to Settlements, Living biomass	CO_2	**0.94**	**0.78**	**0.48**	Tier 3
5E2	Land converted to Settlements, Dead organic matter	CO_2	**0.03**	**0.58**	**1.23**	Tier 2
5C1	Grassland remaining Grassland, Managed Grassland, Living biomass	CO_2	**0.37**	**0.58**	**0.79**	Tier 3
5C2	Forest converted to Grassland, Living biomass	CO_2	**0.16**	**0.50**	**0.88**	Tier 3
5F2	Land converted to Other land, Soils	CO_2	**0.02**	**0.36**	0.76	Tier 1
5B2	Land converted to Cropland, Soils, Mineral	CO_2	0.01	0.36	**0.75**	Tier 1
5A2	Land converted to Forest Land, Dead organic matter	CO_2	0.01	0.28	**0.60**	Tier 2
Tier 1 key categories (large contribution to the total emissions)						
No additional categories – all Tier 1 key categories were also key at Tier 2.						

Bold figures indicate whether the source category is key in the tier 2 analysis.

Table AI-4. Summary of identified key categories Tier 1. Excluding LULUCF. Per cent contribution to the total uncertainty in level and/or trend

	Source category	Gas	Level assessment Tier 1 1990	Level assessment Tier 1 2011	Trend assessment Tier 1 1990-2011
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous	CO_2	**10.30**	**22.55**	**28.27**

	Fuels				
1A3b	Road Transportation	CO_2	**15.15**	**18.70**	**8.18**
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Liquid Fuels	CO_2	**12.74**	**9.83**	**6.72**
2C2	Ferroalloys Production	CO_2	**5.07**	**4.24**	**1.92**
4A	Enteric Fermentation	CH_4	**4.60**	**3.79**	**1.87**
1A3d	Navigation	CO_2	**3.37**	**3.77**	**0.93**
1A4	Other sectors - Mobile Fuel Combustion	CO_2	**3.64**	**3.44**	**0.45**
2C3	Aluminium Production	CO_2	**2.82**	**3.15**	**0.76**
1A3e	Other (snow scooters, boats, motorized equipment)	CO_2	**1.51**	**3.08**	**3.62**
1B2c	Venting and Flaring	CO_2	**2.98**	**2.90**	0.18
4D1	Direct soil emissions	N_2O	**2.86**	**2.38**	**1.11**
1A3a	Civil Aviation	CO_2	**1.35**	**2.25**	**2.08**
6A	Solid Waste Disposal on Land	CH_4	**3.42**	**2.01**	**3.26**
1B2a	Oil (incl. oil refineries, gasoline distribution)	CO_2	**2.28**	**1.99**	**0.65**
2F	Consumption of Halocarbons and Sulphur Hexafluoride	HFCs	0.00	**1.78**	**4.11**
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Solid Fuels	CO_2	**2.02**	**1.72**	**0.70**
2A1	Cement Production	CO_2	**1.26**	**1.40**	0.33
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Other Fuels	CO_2	0.20	**1.18**	**2.28**

4D3	Indirect emissions	N_2O	**1.06**	**0.96**	0.23
2B5	Other Chemical Industry	CO_2	**0.57**	**0.80**	**0.52**
1B2c	Venting and Flaring	CH_4	0.30	**0.62**	**0.74**
2B1	Ammonia Production	CO_2	**0.99**	**0.61**	**0.89**
4B	Manure Management	CH_4	**0.59**	**0.58**	0.02
2B2	Nitric Acid Production	N_2O	**4.12**	**0.54**	**8.25**
2C3	Aluminium Production	PFCs	**6.69**	**0.42**	**14.46**
2A2	Lime Production	CO_2	0.10	**0.42**	**0.74**
1A5b	Military - Mobile	CO_2	**0.78**	0.40	**0.89**
1A3e	Other (snow scooters, boats, motorized equipment)	N_2O	0.14	0.34	**0.46**
2B4	Carbide Production	CO_2	**0.79**	0.13	**1.54**
2C4	SF_6 Used in Aluminium and Magnesium Foundries	SF_6	**4.26**	.	.

Bold figures indicate whether the source category is key.

Table AI-5. Summary of identified key categories Tier 2. Including LULUCF. Per cent contribution to the total uncertainty in level and/or trend. Categories identified only in the analysis without LULUCF are included.

	Source category	**Gas**	**Level assessment Tier 2 1990**	**Level assessment Tier 2 2011**	**Trend assessment Tier 2 1990-2011**
5A1	Forest Land remaining Forest Land, Forest inventory area, Living Biomass	CO_2	**12.13**	**20.38**	**28.56**
5A1	Forest Land remaining Forest Land, Forest inventory area, Soils, Organic	CO_2	**19.90**	**16.66**	**10.78**

4D1	Direct soil emissions	N_2O	**11.60**	**8.13**	**2.88**
5A1	Forest Land remaining Forest Land, Forest inventory area, Dead organic matter	CO_2	**13.05**	**7.57**	0.15
5E2	Land converted to Settlements, Soils	CO_2	0.29	**6.58**	**13.79**
5B1	Cropland remaining Cropland, Arable, Soils (organic)	CO_2	**9.13**	**6.02**	**1.45**
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous Fuels	CO_2	**1.84**	**3.40**	**5.00**
4D3	Indirect emissions	N_2O	**2.88**	**2.19**	**1.10**
1A3b	Road Transportation	CO_2	**1.96**	**2.04**	**1.92**
4A	Enteric Fermentation	CH_4	**2.60**	**1.81**	**0.61**
2F	Consumption of Halocarbons and Sulphur Hexafluoride	HFCs	0.00	**1.67**	**3.59**
1B2a	Oil (incl. oil refineries, gasoline distribution)	CO_2	**2.03**	**1.50**	**0.66**
5A2	Land converted to Forest Land, Soils, Mineral	CO_2	0.05	**1.44**	**3.05**
1A3d	Navigation	CO_2	**1.51**	**1.43**	**1.16**
6A	Solid Waste Disposal on Land	CH_4	**2.74**	**1.36**	0.54
1A3e	Other (snow scooters, boats, motorized equipment)	CO_2	**0.68**	**1.16**	**1.65**
5A2	Land converted to Forest Land, Living biomass	CO_2	0.35	**0.86**	**1.41**
1A3a	Civil Aviation	CO_2	0.61	**0.85**	**1.07**
1B2c	Venting and Flaring	CH_4	0.49	**0.84**	**1.20**
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Liquid Fuels	CO_2	**1.20**	**0.78**	0.17

5E2	Land converted to Settlements, Living biomass	CO_2	**0.94**	**0.78**	0.48
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Other Fuels	CO_2	0.13	**0.67**	**1.28**
1A4	Other sectors - Mobile Fuel Combustion	CO_2	**0.84**	**0.67**	0.38
1A3e	Other (snow scooters, boats, motorized equipment)	N_2O	0.31	**0.64**	**0.99**
2C3	Aluminium Production	CO_2	**0.65**	**0.61**	0.50
1B2c	Venting and Flaring	CO_2	**0.71**	0.59	0.36
5E2	Land converted to Settlements, Dead organic matter	CO_2	0.03	0.58	**1.23**
5C1	Grassland remaining Grassland, Managed Grassland, Living biomass	CO_2	0.37	0.58	**0.79**
4D2	Animal production	N_2O	**0.81**	0.57	0.21
5C2	Forest converted to Grassland, Living biomass	CO_2	0.16	0.50	**0.88**
5F2	Land converted to Other land, Soils	CO_2	0.02	0.36	**0.76**
5B2	Land converted to Cropland, Soils, Mineral	CO_2	0.01	0.36	**0.75**
5A2	Land converted to Forest Land, Dead organic matter	CO_2	0.01	0.28	**0.60**
2C3	Aluminium Production	PFCs	**3.01**	0.16	**3.44**

Bold figures indicate whether the source category is key.
Source categories with no bold face data were identified only in the analysis without LULUCF.

Table AI-6. Summary of identified key categories Tier 1. Including LULUCF. Per cent contribution to the total uncertainty in level and/or trend. Categories identified only in the analysis without LULUCF are included.

	Source category	**Gas**	**Level assessment Tier 1 1990**	**Level assessment Tier 1 2011**	**Trend assessment Tier 2 1990-2011**

5A1	Forest Land remaining Forest Land, Forest inventory area, Living Biomass	CO_2	**18.40**	**30.82**	**38.24**
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous Fuels	CO_2	**6.94**	**12.76**	**16.60**
1A3b	Road Transportation	CO_2	**10.21**	**10.58**	**8.80**
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Liquid Fuels	CO_2	**8.58**	**5.56**	**1.04**
5A1	Forest Land remaining Forest Land, Forest inventory area, Dead organic matter	CO_2	**7.92**	**4.58**	0.08
2C2	Ferroalloys Production	CO_2	**3.42**	**2.40**	**0.77**
4A	Enteric Fermentation	CH_4	**3.10**	**2.15**	**0.64**
1A3d	Navigation	CO_2	**2.27**	**2.13**	**1.54**
5E2	Land converted to Settlements, Soils	CO_2	0.09	**2.04**	**3.79**
1A4	Other sectors - Mobile Fuel Combustion	CO_2	**2.45**	**1.95**	**0.98**
5B1	Cropland remaining Cropland, Arable, Soils (organic)	CO_2	**2.77**	**1.82**	**0.39**
5A1	Forest Land remaining Forest Land, Forest inventory area, Soils, Organic	CO_2	**2.16**	**1.80**	**1.03**
2C3	Aluminium Production	CO_2	**1.90**	**1.78**	**1.28**
1A3e	Other (snow scooters, boats, motorized equipment)	CO_2	**1.02**	**1.74**	**2.19**
1B2c	Venting and Flaring	CO_2	**2.01**	**1.64**	**0.89**
4D1	Direct soil emissions	N_2O	**1.93**	**1.35**	**0.42**
1A3a	Civil Aviation	CO_2	**0.91**	**1.27**	**1.41**

6A	Solid Waste Disposal on Land	CH_4	**2.31**	**1.14**	**0.40**
1B2a	Oil (incl. oil refineries, gasoline distribution)	CO_2	**1.53**	**1.13**	**0.44**
2F	Consumption of Halocarbons and Sulphur Hexafluoride	HFCs	0.00	**1.01**	**1.92**
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Solid Fuels	CO_2	**1.36**	**0.97**	**0.34**
2A1	Cement Production	CO_2	**0.85**	**0.79**	**0.57**
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Other Fuels	CO_2	0.13	**0.67**	**1.13**
4D3	Indirect emissions	N_2O	**0.71**	**0.54**	0.24
5E2	Land converted to Settlements, Living biomass	CO_2	**0.57**	**0.47**	0.26
2B5	Other Chemical Industry	CO_2	0.39	**0.45**	**0.43**
5A2	Land converted to Forest Land, Soils, Mineral	CO_2	0.01	**0.41**	**0.76**
5E2	Land converted to Settlements, Dead organic matter	CO_2	0.02	**0.35**	**0.66**
1B2c	Venting and Flaring	CH_4	0.20	**0.35**	**0.45**
2B1	Ammonia Production	CO_2	**0.67**	**0.34**	0.09
4B	Manure Management	CH_4	0.40	0.33	0.19
2B2	Nitric Acid Production	N_2O	**2.77**	0.31	**2.50**
2C3	Aluminium Production	PFCs	**4.51**	0.24	**4.56**
2A2	Lime Production	CO_2	0.07	0.24	**0.38**
1A5b	Military - Mobile	CO_2	**0.53**	0.23	0.16

2B4	Carbide Production	CO_2	**0.54**	0.07	**0.46**
2C4	SF_6 Used in Aluminium and Magnesium Foundries	SF_6	**2.87**	.	.

Bold figures indicate whether the source category is key.
Source categoryes with no bold face data were identified only in the analysis without LULUCF.

Table AI-7. Background data for the key category analyses.

	Category - Fuel	CO_2 Gg		CH_4 Gg CO_2 eq.		N_2O Gg CO_2 eq.		Uncertainty activity 2σ, %	Uncertainty emission factor 2σ, %		
		1990	2011	1990	2011	1990	2011		CO_2	CH_4	N_2O
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Biomass	.	.	119.20	152.41	46.01	53.74	30	.	72	100
	Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous Fuels	5185.35	12034.30	41.05	87.23	13.51	29.75	4	7	72	100
	Stationary Fuel Combustion (1A1-1A2-1A4), Liquid Fuels	6416.32	5243.12	14.31	6.72	20.00	14.07	3	3	72	100
	Stationary Fuel Combustion (1A1-1A2-1A4), Other Fuels	99.77	632.22	1.92	5.76	4.31	8.04	5	30	72	100
	Stationary Fuel Combustion (1A1-1A2-1A4), Solid Fuels	1017.57	915.82	2.03	0.57	2.79	2.78	5	7	72	100
1A3a	Civil Aviation	679.38	1200.02	0.35	0.85	6.69	11.81	20	3	72	100
1A3b	Road Transportation	7630.18	9977.69	71.45	16.16	57.66	67.66	5	3	45	65
1A3c	Railways	96.40	38.16	0.12	0.05	11.27	4.44	5	3	72	100
1A3d	Navigation	1696.41	2011.92	4.47	63.41	11.06	13.83	20	3	72	100
1A3e	Other (snow scooters, boats, motorized equipment)	760.31	1642.80	6.84	10.07	68.92	179.66	20	3	72	100
1A4	Other sectors - Mobile Fuel Combustion	1831.92	1835.92	3.46	2.96	67.02	59.79	10	3	72	100
1A5a	Military - Stationary	62.45	29.96	0.17	0.15	0.18	0.38	5	5	72	100
1A5b	Military - Mobile	393.74	212.23	0.33	2.14	5.96	3.95	5	5	72	100

1B1a	Coal Mining	7.37	5.08	56.49	38.92	.	.	3	72	72	.
1B2a	Oil (incl. oil refineries, gasoline distribution)	1145.91	1063.49	164.41	205.17	.	.	3	40	40	.
1B2b	Natural Gas	4.11	12.44	2.52	47.68	.	.	3	72	72	.
1B2c	Venting and Flaring	1502.33	1549.13	152.90	333.04	4.36	3.32	4	10	72	100
2A1	Cement Production	634.26	748.93	.	.	.	.	0.44	0.57	.	.
2A2	Lime Production	49.85	223.55	.	.	.	.	0.36	0.48	.	.
2A3	Limestone and Dolomite Use	23.74	23.63	.	.	.	.	14.12	7	.	.
2A4	Soda Ash Production and Use	15.23	4.33	.	.	.	.	15	7	.	.
2A7	Other	5.58	4.70	.	.	.	.	0.08	7	.	.
2B1	Ammonia Production	500.12	323.16	.	.	.	.	3	7	.	.
2B2	Nitric Acid Production	.	.	.	.	2073.59	288.74	0	.	.	5.99
2B4	Carbide Production	400.30	68.72	7.36	2.27	.	.	3	10	10	.
2B5	Other Chemical Industry	289.45	427.59	1.62	2.91	0.02	0.61	9	0.74	72	0
2C1	Iron and Steel Production	12.35	25.57	.	.	.	.	1.23	1.30	.	.
2C2	Ferroalloys Production	2553.70	2262.57	1.04	1.16	5.22	4.47	0	3	72	10
2C3	Aluminium Production	1419.00	1679.54	.	.	.	.	3	10	.	.
2C5	Other Metal Production	160.86	86.12	.	.	.	.	10	10	.	.
2D1	Pulp and Paper	10.43	9.59	.	.	.	.	0.92	10	.	.
2D2	Food and Drink	66.87	170.00	.	.	.	.	10	10	.	.

2G	Other (Paraffin Wax)	6.23	52.27	.	.	.	.	30	10	.	.
3	Total solvent and other product use	155.65	136.51	.	.	35.53	44.04	0	10	.	15
4A	Enteric Fermentation	.	.	2316.76	2023.10	.	.	5	.	25	.
4B	Manure Management	.	.	298.17	311.19	152.75	149.12	CH_4: 5 N_2O: 24	.	25	72
4D1	Direct soil emissions	.	.	.	.	1440.97	1270.52	30	.	.	180
4D2	Animal production	.	.	.	.	243.58	215.72	22	.	.	72
4D3	Indirect emissions	.	.	.	.	534.27	512.59	70	.	.	100
4F1	Cereals	.	.	20.27	1.77	5.85	0.51	10	.	72	100
6A	Solid Waste Disposal on Land	.	.	1723.37	1071.98	.	.	20	.	30	.
6B	Wastewater Handling	.	.	19.51	9.70	117.07	139.44	25	.	50	70
6C	Waste Incineration	0.19	.	0.01	0.06	0.07	0.07	30	30	72	100

	Category - Fuel	**HFCs Gg CO_2 eq.**		**PFCs Gg CO_2 eq.**		**SF6 Gg CO_2 eq.**		**Uncertainty activity**	**Uncertainty emission factor 2σ, %**		
		1990	**2011**	**1990**	**2011**	**1990**	**2011**	**2σ, %**	**HFCs**	**PFCs**	**SF_6**
2C3	Aluminium Production	.	.	3370.40	225.73	.	.	3	.	20	.
2C4	SF_6 Used in Aluminium and Magnesium Foundries	.	.	.	.	2143.83	.	0	.	.	0.25
2F	Consumption of Halocarbons and Sulphur Hexafluoride	0.05	950.39	.	.	55.95	60.72	0	50	.	60

	Category - Fuel	CO_2 Gg		CH_4 Gg CO_2 eq.		N_2O Gg CO_2 eq.		Uncertainty activity 2σ, %	Uncertainty emission factor 2σ, %		
		1990	2011	1990	2011	1990	2011		CO_2	CH_4	N_2O
52C	Forest converted to Grassland, Soils	0.30	37.55	.	.	.	.	0	130.86	.	.
5A	Forest Land remaining Forest Land, Drainage	.	.	.	.	11.29	11.95	0	.	.	280
5A1	Forest Land remaining Forest Land, Fertilizer	.	.	.	.	1.42	0.51	0	.	.	180
	Forest Land remaining Forest Land, Forest inventory area, Dead organic matter	-5918.66	-4318.64	.	.	.	.	0	50	.	.
	Forest Land remaining Forest Land, Forest inventory area, Living Biomass	-13757.60	-29058.10	.	.	.	.	0	20	.	.
	Forest Land remaining Forest Land, Forest inventory area, Soils, Mineral	-23.76	-17.34	.	.	.	.	0	25	.	.
	Forest Land remaining Forest Land, Forest inventory area, Soils, Organic	1611.83	1697.26	.	.	.	.	0	280	.	.
	Forest Land remaining Forest Land, Wildfires	.	.	1.11	0.22	0.11	0.02	0	.	75	75
5A2	Land converted to Forest Land, Dead organic matter	-5.57	-161.88	.	.	.	.	0	50	.	.
	Land converted to Forest Land, Living biomass	-44.30	-138.39	.	.	.	.	0	177	.	.
	Land converted to Forest Land, Soils, Mineral	-10.26	-382.75	.	.	.	.	0	107.62	.	.
5B	Cropland remaining Cropland, Liming	224.55	61.16	.	.	.	.	0	10	.	.
5B1	Cropland remaining Cropland, Arable, Soils	2069.39	1716.00	.	.	.	.	0	1	.	.

	Cropland remaining Cropland, Horticulture, Living biomass	-15.76	28.00	.	.	.	.	0	75	.	.
5B2	Cropland, Disturbance	.	.	.	.	0.35	10.15	0	.	.	280
	Land converted to Cropland, Dead organic matter	1.69	48.06	.	.	.	.	0	50	.	.
	Land converted to Cropland, Living biomass	61.69	.	.	.	.	.	0	112	.	.
	Land converted to Cropland, Soils, Mineral	1.43	70.60	.	.	.	.	0	143.68	.	.
5C1	Grassland remaining Grassland, Managed Grassland, Living biomass	-38.00	-75.11	.	.	.	.	0	221	.	.
	Grassland remaining Grassland, Managed Grassland, Soils	.	58.47	.	.	.	.	0	96.14	.	.
5C2	Forest converted to Grassland, Dead organic matter	0.62	78.47	.	.	.	.	0	50	.	.
	Forest converted to Grassland, Living biomass	19.14	76.15	.	.	.	.	0	188	.	.
5D	Land converted to Wetland, Drainage	.	.	.	.	0.05	0.05	0	.	.	280
5D1	Wetland remaining Wetland, Peat extraction, Soils	3.37	3.37	.	.	.	.	0	1	.	.
	Wetlands remaining Wetlands, Living biomass	-61.83	-87.13	.	.	.	.	0	73	.	.
5D2	Land converted to wetland, Dead organic matter	.	7.43	.	.	.	.	0	50	.	.
	Land converted to wetland. Soil	.	-6.96	.	.	.	.	0	220.23	.	.
5F2	Land converted to Other land, Soils	1.81	46.95	.	.	.	.	0	220.23	.	.
5G	Other; Liming of lakes and rivers	10.12	16.78	.	.	.	.	0	10	.	.
5E2	Land converted to Settlements, Dead organic matter	11.68	333.34	.	.	.	.	0	50	.	.

Land converted to Settlements, Living biomass	428.06	443.28	.	.	.	.	0	50	.	.
Land converted to Settlements, Soils	68.12	1927.67	.	.	.	.	0	97.31	.	.

Annex II: Tier 2 uncertainty analysis of the Norwegian Greenhouse Gas Emission Inventory

Summary

The national greenhouse gas (GHG) emission inventory is compiled from estimates based on emission factors and activity data and direct measurements by plants. All these data and parameters will contribute to the overall inventory uncertainty. The uncertainties and probability distributions of the inventory input parameters have been assessed based on available data and expert judgements. Finally, the level and trend uncertainties of the national GHG emission inventory have been estimated using Monte Carlo simulation. The methods used in the analysis correspond to an IPCC Tier 2 method, as described in (IPCC 2000). Analyses have been made both excluding and including the sector LULUCF (land use, land-use change and forestry).

The uncertainty analysis performed in 2011 was an update of the uncertainty analyses performed for the greenhouse gas inventory in 2006 and 2000. The report *Uncertainties in the Norwegian Greenhouse Gas Emission Inventory* (Statistics Norway (2000)) includes more detailed documentation of the analysis method used in all analyses. In this note we mainly focus on the changes since last analysis in 2006. This includes new methodology for several source categories as well as revised uncertainty estimates.

During the project we have been in contact with experts, and have collected information about uncertainty from them. There has been a focus on the sources where methodological changes has been made since the last uncertainty analysis was performed in 2006. For the industries included in EU's emission trading system, new information from the reports about uncertainty in activity data and CO_2 emission factor has been used. This has improved the quality of the uncertainty estimates for the energy and manufacturing sectors.

The results show that the uncertainty in the calculated greenhouse gas emissions for 2009 is ±5 per cent. The uncertainty estimate is lower now than earlier analyses have shown. This is partly due to a considerable work made to improve the calculation methodology. It is also partly the uncertainty estimates themselves that have been improved.

Level of the analysis

The uncertainty analysis is performed at the most detailed level of IPCC source categories (IPCC 2000). For some sources even a more detailed separation is made, e.g. where different pollutants from a source sector have to be connected to different activity measures, as for example for the source category 6B Waste water, or to be able to consider dependencies between only parts of the source groups, which for example is the case for the source categories 4D1 Direct soil emissions and 4D3 Indirect soil emissions. Energy carriers have been grouped into five main types; solid, gaseous, liquid, waste and bio energy. The placement into groups has been made using international definitions based on the type of the original energy carrier, *e.g*, refinery gas and fuel gas is placed in "liquid" and CO gas is placed in "solid". This is a change from last analysis when all these three gases were placed on "gaseous" fuel. This change affects the allocation of emissions on sources with different uncertainty estimates. The definitions of sources have also been changed to some extent since

last analysis, and this also affects the results of the uncertainty analysis. The most important changes are:

- Emissions from mobile installations in oil and gas exploration have been moved from "Mobile combustion-Coastal traffic" to "Stationary combustion-Oil and gas extraction".
- Emissions from district heating and electricity production are now placed in a new category called Energy supply.
- There are some minor adjustments in limitation and also some changes of names and order.

In Table AII-3, source category level used in the study is listed.

For some emission sources a separation into activity and emission factors is not possible due to lack of information. Examples are estimates based on measurements, emissions reported by plants (in the cases when the plants have only reported emissions and not activity data and emission factor used), and emissions that are aggregated from sources with diverse methods (for example emissions from 2C5 Other metal production). These emissions have been assigned activity equal to 1, and emission factor to be equal to the estimated value. This is possible since the total uncertainty estimate is independent of scale for activity and emission factor[1]. Emissions from landfills, HFCs and some other sources have been transferred into the form of emission factor multiplied with activity rate, in spite of the fact that the estimates are based on more complex estimation models (e.g. taking time lag into account and using several activity data and emission factors).

Table 6.2 from the IPCC good practice guidance is included in the Annex as Table AII-4. This is as a response to recommendations in previous ERT review reports. Column G in Table AII-4 (6.2) is estimated as uncertainty for source category divided by total GHG emissions.

Uncertainties in input parameters

Emission estimates

In the analysis emission estimates for the different source categories (Table AII-3) for the years 1990 and 2009 are taken from the Norwegian emission inventory.

Formatert: Ikke Utheving

The emission estimates used in the analysis comes from the national GHG emission inventory and is based on Norwegian measurements, literature data or statistical surveys. Some data are based on expert judgements.

Standard deviation and probability density

The probability densities used in this study have been divided into four types of model shapes:

1. Normal distribution
2. Truncated normal distribution
3. Lognormal distribution
4. Beta distribution

1 We may state the activity in any given unit, as long as the emission factor is stated in the corresponding unit. Examples: tonnes and kg/tonne, Gg and kg/Gg, or, as in this case, unit value and total emissions in kg.

For low uncertainties all the distributions 2-4 above approach the normal distributions. For large uncertainties the normal distribution may lead to negative values. To avoid this, the distributions are when necessary truncated at 0, which means that there is a given probability of the value 0. The lognormal distribution and beta distribution are both asymmetrical distributions, giving a heavier tail of probabilities towards higher values. These two distributions are very similar in shape for low to medium size uncertainties. For higher uncertainties the beta distribution is more flat and the peak in the distribution is more close to the mean value. The beta distribution is, however, only defined for variables taking values between 0 and 1.

The densities were used in the following way: Normal or lognormal distributions were used for most of the categories. Normal distribution was used for uncertainties up to 30 percent, while lognormal distribution was used for higher uncertainties. Normal distribution was also used for carbon balances that were in principle a difference between larger gains and losses that likely were normally distributed with lower uncertainties. These carbon balances might take both positive and negative values. Beta distribution and truncated normal distribution were used only in a few special cases. Beta distribution was used for N_2O emissions from combustion. Truncated normal distribution was used for CH_4 emissions from stationary combustion of liquid fuels, and from flaring.

The uncertainties and densities given in the following sections are based on information for 2009. However, they were also used for 1990 and for the trend analysis. In reality, due to improved methods, the quality of the 2009 data inventory is higher than that of the 1990 data for several categories. Thus, the analysis may underestimate the uncertainty in 1990 emissions and in the trend. The CO_2 emissions are likely most affected by this problem.

Activity data

The assessed standard deviations and corresponding probability densities are summarised in Table AII-1.

Table AII-1. Summary of standard deviation and probability density of activity data

IPCC Source category	Pollutant source	Standard deviation (2σ). per cent[1]	Density shape	Source/ comment
1A1, 1A2	Coal/coke - general	5	Normal	Expert judgement industry, Norcem (2006)
1A1B	Coal/coke – petroleum refining	1.1	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A2A	Coal/coke - iron and steel	4.1	Normal	Emission trading scheme (Klif 2011), Expert judgement industry, Norcem (2006)
1A2F	Coal/coke - other	0.8	Normal	Emission trading scheme (Klif 2011), Expert judgement industry, Norcem (2006)
1A4B	Coal/coke - residential	20	Normal	Expert judgement, Statistics Norway (2000)
1A4C	Coal/coke - agriculture	30	Normal	Expert judgement, Statistics Norway
1A1, 1A2, 1A4	Wood	30	Lognormal	Expert judgement, Statistics Norway (2000)
1A1A	Gas – public electricity and heat production	0.8	Normal	Emission trading scheme (Klif 2011), Expert judgement, Statistics Norway
1A2	Gas - general	4	Normal	Norwegian Petroleum Directorate, Statistics Norway (2000)
1A1C	Gas - manufacture of solid fuels and other energy industries	0.2	Normal	Emission trading scheme (Klif 2011), NPD (2006)
1A2C	Gas - chemicals	1.7	Normal	Emission trading scheme (Klif 2011), Norwegian Petroleum Directorate, Statistics Norway (2000)
1A2D	Gas - pulp, paper, print	1.7	Normal	Emission trading scheme (Klif 2011), Norwegian Petroleum Directorate, Statistics Norway (2000)
1A4A	Gas - commercial/institutional	10	Normal	Expert judgement, Statistics Norway
1A4B, 1A4C	Gas - residential, agriculture/forestry/fishing	30	Normal	Expert judgement, Statistics Norway
1A1, 1A2	Oil - general	3	Normal	Spread in data, Statistics Norway (2000)
1A1B	Oil - petroleum refining	1.1	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A1C	Oil – manufacture of solid fuels and other energy industries	1.8	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A2A	Oil - iron and steel	0.5	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A2C	Oil - chemicals	14.4	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A2D	Oil – pulp, paper, print	0.7	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A2F	Oil - other	2.6	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A4A	Oil - commercial/institutional	20	Normal	Expert judgement, Statistics Norway
1A4B	Oil - residential	9.5	Normal	Emission trading scheme (Klif 2011), Expert judgement, Statistics Norway
1A4C	Oil - agriculture/forestry	10	Normal	Expert judgement, Statistics Norway
1A1A	Waste – general	5	Normal	Expert judgement, Statistics Norway (2000)
1A2F	Waste - other manufacturing	3.2	Normal	Emission trading scheme (Klif 2011), Expert judgement, Statistics Norway (2000)
1A4A	Waste - commercial/institutional	30	Lognormal	Expert judgement, Statistics Norway (2000)
1A3A, 1A3E	Transport fuel - civil aviation, motorized equipment and pipeline	20	Normal	Expert judgement, Statistics Norway (2000)
1A3B	Transport fuel - road	5	Normal	Expert judgement, Statistics Norway
1A3C	Transport fuel - railway	5	Normal	Expert judgement, Statistics Norway
1A3D	Transport fuel - navigation	20	Normal	Expert judgement, Statistics Norway
1A5A, 1A5B	Military fuel - stationary and mobile	5	Normal	Expert judgement, Statistics Norway
1B1A, 1B2B	Coal mining, extraction of natural gas	3	Normal	Expert judgement, Statistics Norway (2000)
1B2A	Extraction of oil - transport, refining/storage	3	Normal	Expert judgement, Statistics Norway (2000)

Annex II

IPCC Source category	Pollutant source	Standard deviation (2σ). per cent[1]	Density shape	Source/ comment
1B2A	Extraction of oil - distribution gasoline	5	Normal	Expert judgement, Statistics Norway (2000)
1B2C	Venting	-	-	See emission factor
1B2C	Flaring	1.4	Normal	Emission trading scheme (Klif 2011), Expert judgement, Statistics Norway (2000)
1B2C	Well testing	30	Normal	Expert judgement, Statistics Norway (2000)
2A1	Cement production	0.4	Normal	Emission trading scheme (Klif 2011)
2A2	Lime production	0.4	Normal	Emission trading scheme (Klif 2011)
2A3	Limestone and dolomite use	14.1	Normal	Emission trading scheme (Klif 2011)
2A7	Other mineral production	0.1	Normal	Emission trading scheme (Klif 2011)
2B1	Ammonia production	3	Normal	Expert judgement industry, Yara (2006)
2B2	Nitric acid production	-	-	See emission factor
2B4	Carbide production - SiC	3	Normal	Expert judgement industry, St. Gobain and Orkla Exolon (2006)
2B4	Carbide production - CaC	3	Normal	Expert judgement, Statistics Norway (2000)
2B5	Methanol and plastic production	9.0	Normal	Emission trading scheme (Klif 2011)
2C1	Iron and steel production	1.23	Normal	Expert judgement industry, Tinfos (2006)
2C2	Ferroalloys production	-	-	See emission factor
2C3	Aluminium production	3	Normal	Expert judgement industry, Norsk Hydro (2006a)
2C4	SF_6 used in Al and Mg foundries	-	-	See emission factor
2C5	Mg production	0.25	Normal	Expert judgement industry, Norsk Hydro (2006b)
2C5	Ni production, anodes	10	Normal	Expert judgement, Statistics Norway
2D1	Pulp and paper	0.9	Normal	Emission trading scheme (Klif 2011)
2D2	Carbonic acid, bio protein	10	Normal	Expert judgement, Statistics Norway
2F	Consumption of halocarbons and SF_6	-	-	See emission factor
3A, 3B, 3C, 3D	Solvent and other product use - CO_2	-	-	See emission factor
3D	Use of N_2O in anasthesia and as propellant – N_2O	-	-	See emission factor
4A	Enteric fermentation	5	Normal	Expert judgement, Statistics Norway (2006a), Division for agricultural statistics
4B1-9, 4B13	Manure management - CH_4	5	Normal	Expert judgement, Statistics Norway (2006a), Division for agricultural statistics
4B11-12	Manure management - N_2O	24	Normal	Expert judgement[2], Statistics Norway (2006a), Statistics Norway (2006b), and Statistics Norway (2006c)
4D1	Direct soil emission - fertilizer	5	Normal	SFT (1999a)
4D1	Direct soil emission - manure	20	Normal	Statistics Norway (2000)
4D1	Direct soil emission - other	64	Lognormal	Expert judgement[3], Statistics Norway and Statistics Norway (2000)
4D1	Direct soil emission - organic soil	Fac2	Lognormal	Expert judgement, Statistics Norway
4D2	Animal production	22	Normal	Expert judgement[4], Statistics Norway
4D3	Indirect soil emission - deposition	30	Lognormal	SFT (1999a)
4D3	Indirect soil emission - leakage	70	Lognormal	SFT (1999a)
4F1	Agricultural residue burning	10	Normal	Expert judgement, Statistics Norway
5A1	Forest Land remaining Forest Land, - general	-	-	See emission factor
5A1	Forest Land remaining Forest Land - wildfires	20	Normal	Expert judgement, Statistics Norway
5A2	Land converted to Forest Land	-	-	See emission factor
5B1	Cropland remaining Cropland - general	-	-	See emission factor
5B1	Cropland remaining Cropland - liming	5	Normal	Expert judgement, Statistics Norway
5B2	Land converted to Cropland	-	-	See emission factor
5C1	Grassland remaining Grassland	-	-	See emission factor
5C2	Cropland converted to Grassland	-	-	See emission factor

Annex II

IPCC Source category	Pollutant source	Standard deviation (2σ). per cent[1]	Density shape	Source/ comment
5D1	Wetlands remaining Wetlands	-	-	See emission factor
5D2	Land converted to Wetland	-	-	See emission factor
5E2	Land converted to Settlements	-	-	See emission factor
5F2	Land converted to Other land	-	-	See emission factor
5G	Other; Liming of lakes and rivers	5	Normal	Expert judgement, Statistics Norway
6A	Solid waste disposal	20	Normal	Expert judgement, Statistics Norway (2010) and SFT (2006a)
6B	Waste water treatment - CH_4	1	Lognormal	Expert judgement, Statistics Norway
6B	Waste water treatment - N_2O pipeline and plant	25	Normal	Expert judgement, Statistics Norway (2006e)
6B	Waste water treatment - N_2O, not connected	30	Normal	Expert judgement, Statistics Norway (2011)
6C	Waste incineration	30	Normal	Expert judgement, Statistics Norway

[1] Strongly skewed distributions are characterised as *fac3* etc, indicating that 2σ is a factor 3 below and above the mean.
[2] Population 5% (Statistics Norway 2006a), Nex 15% (Statistics Norway 2006b), distribution AWMS 10% (Statistics Norway 2006c), distribution pasture/ storage 15% (Statistics Norway 2006b)
[3] N fixation 40% and crop residues 50% (Statistics Norway 2000)
[4] Population 5% (Statistics Norway 2006a), Nex 15% (Statistics Norway 2006b, distribution pasture/ storage 15% (Statistics Norway 2006b)

Emission factors

The assigned values and probability densities are shown in Table AII-2.

Table AII-2. Summary of standard deviation and probability density of emission factors

IPCC Source category	Pollutant source	Gas	(2σ). per cent[1]	Density shape	Source/ comment
1A1, 1A2B, 1A2D, 1A2E, 1A4	Coal/coke - general	CO_2	7	Normal	Spread in data, Statistics Norway (2000)
1A1B	Coal/coke – petroleum refining	CO_2	0.9	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A2A	Coal/coke – iron and steel	CO_2	16.0	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A2F	Coal/coke - other	CO_2	2.0	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A2, 1A4	Gas - general	CO_2	3.5	Normal	IPCC (2006), expert judgement, Statistics Norway
1A1A	Gas – public electricity and heat prod	CO_2	0.6	Normal	Emission trading scheme (Klif 2011), Norwegian Petroleum Directorate, Statistics Norway (2000)
1A1C	Gas – Manufacture of solid fuels and other energy	CO_2	2.6	Normal	Emission trading scheme (Klif 2011), Norwegian Petroleum Directorate, Statistics Norway (2000)
1A2C	Gas - Chemicals	CO_2	1.6	Normal	Emission trading scheme (Klif 2011), Norwegian Petroleum Directorate, Statistics Norway (2000)
1A1, 1A2, 1A4	Oil - general	CO_2	3	Normal	Spread in data, Statistics Norway (2000)
1A1B	Oil – petroleum refining	CO_2	0.9	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A2C	Oil - Chemicals	CO_2	1.1	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A2F	Oil - other	CO_2	2.6	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A4B	Oil - residential	CO_2	3.4	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A1, 1A4	Waste - general	CO_2	30	Normal	Spread in data, Statistics Norway (2000)
1A2F	Waste - other	CO_2	25.2	Normal	Emission trading scheme (Klif 2011), Spread in data, Statistics Norway (2000)
1A3A, 1A3B, 1A3C, 1A3D	Transport fuel	CO_2	3	Normal	Spread in data, Statistics Norway (2000)
1A5	Military fuel - stationary and mobile	CO_2	5	Normal	Expert judgement, Statistics Norway
1A1, 1A2, 1A4	Coal/coke, wood, waste - general	CH_4	Fac2	Lognormal	Spread in data, Statistics Norway (2000)
1A1B	Coal/coke – petroleum refining	CH_4	Fac2	Truncated N	Spread in data, Statistics Norway (2000)
1A1, 1A2, 1A4, 1A5	Gas – general, military fuel – stationary and mobile	CH_4	Fac2	Lognormal	Expert judgement, Statistics Norway
1A1, 1A2, 1A4	Oil - general	CH_4	Fac2	Truncated N	Spread in data, Statistics Norway (2000)
1A3A, 1A3C, 1A3D	Transport fuel	CH_4	Fac2	Lognormal	Spread in data. Expert judgement, Statistics Norway (2000)
1A3B	Transport fuel	CH_4	45	Lognormal	(Gustafsson 2005)
1A1, 1A2, 1A4, 1A5	Coal/coke, wood, gas, waste – general, military fuel – stationary and mobile	N_2O	Fac3	Beta	Expert judgement, Statistics Norway
1A1, 1A2, 1A4	Oil - general	N_2O	Fac3	Beta	Spread in data. Expert judgement. IPCC (1997), Statistics Norway (2000)
1A1B	Coal/coke – petroleum refining	N_2O	Fac3	Beta	Spread in data. Expert judgement. IPCC (1997), Statistics Norway (2000)
1A3A, 1A3C, 1A3D	Transport fuel	N_2O	Fac3	Beta	Spread in data. Expert judgement, Statistics Norway (2000)
1A3B	Transport fuel	N_2O	65	Lognormal	(Gustafsson 2005)
1B1A, 1B2B	Coal mining, extraction of natural gas	CO_2	Fac2	Lognormal	Expert judgement, Statistics Norway
1B2A	Extraction of oil - transport, refining/storage, distribution gasoline	CO_2	40	Lognormal	Expert judgement, Statistics Norway
1B2C	Venting	CO_2	Fac2	Lognormal	Expert judgement, Statistics Norway (2000)
1B2C	Flaring	CO_2	4.5	Normal	Emission trading scheme (Klif 2011), Statistics Norway (2000)
1B2C	Well testing	CO_2	7	Normal	Expert judgement, Statistics Norway (2000)
1B1A, 1B2B, 1B2C	Coal mining, extraction of natural gas, venting	CH_4	Fac2	Lognormal	Expert judgement, Statistics Norway (2000)
1B2A	Extraction of oil - transport, refining/storage	CH_4	40	Lognormal	Expert judgement, Statistics Norway

Annex II

IPCC Source category	Pollutant source	Gas	(2σ). per cent[1]	Density shape	Source/ comment
1B2C	Flaring, well testing	CH_4	Fac2	Truncated N	Expert judgement, Statistics Norway (2000)
1B2C	Flaring, well testing	N_2O	Fac3	Beta	Expert judgement, Statistics Norway (2000)
2A1	Cement production	CO_2	0.6	Normal	Emission trading scheme (Klif 2011), IPCC (1997)
2A2	Lime production	CO_2	0.5	Normal	Emission trading scheme (Klif 2011), Expert judgement, Statistics Norway
2A3, 2A7	Limestone and dolomite use, other mineral production	CO_2	7	Normal	Expert judgement, Statistics Norway
2B1	Ammonia production	CO_2	7	Normal	Expert judgement industry, Yara (2006)
2B4	Carbide production - SiC	CO_2	10	Normal	Expert judgement industry, St. Gobain and Orkla Exolon (2006)
2B4	Carbide production - CaC	CO_2	10	Normal	Spread in data, Statistics Norway (2000)
2B5	Methanol and plastic production	CO_2	0.7	Normal	Emission trading scheme (Klif 2011),Expert judgement, Statistics Norway
2B4	Carbide production - SiC	CH_4	10	Normal	SFT (2006b)
2B5	Methanol and plastic production	CH_4	Fac2	Lognormal	Expert judgement, Statistics Norway
2B2	Nitric acid production	N_2O	6.0	Normal	Expert judgement industry, Yara (2006), Emission trading scheme (Klif 2011)
2C1	Iron and steel production	CO_2	1.3	Normal	Emission trading scheme (Klif 2011), Expert judgement industry, Tinfos (2006)
2C2	Ferroalloys production	CO_2	3	Normal	Expert judgement, SINTEF (2006)
2C3	Aluminium production	CO_2	10	Normal	International Aluminium Institute (IAI), Norsk Hydro (2006a)
2C5	Mg production, Ni production, anodes	CO_2	10	Normal	Expert judgement, Statistics Norway
2C2	Ferroalloys production	CH_4	Fac2	Lognormal	Expert judgement, Statistics Norway
2C2	Ferroalloys production	N_2O	10	Normal	Expert judgement, Statistics Norway
2C3	Aluminium production	PFK	20	Normal	Expert judgement industry, Norsk Hydro (2006a)
2C4	SF_6 used in Al and Mg foundries	SF_6	0.25	Normal	Expert judgement industry, Norsk Hydro (2006b)
2D1	Pulp and paper	CO_2	10	Normal	Expert judgement, Statistics Norway
2D2	Carbonic acid, bio protein	CO_2	10	Normal	Expert judgement, Statistics Norway
2F	Consumption of HFK and PFK	HFK/PFK	50	Lognormal	Apply to HFK. Expert judgement, Statistics Norway
2F	Consumption of SF_6	SF_6	60	Lognormal	Expert judgement, Statistics Norway
3A, 3B,3C, 3D	Solvent and other product use	CO_2	10	Normal	Expert judgement, Statistics Norway (2010)
3D	Use of N_2O in anasthesia and as propellant	N_2O	15	Normal	Expert judgement, Statistics Norway (2010)
A1, 4A3	Enteric fermentation - cattle and sheep	CH_4	25	Normal	Expert judgement, UMB (2006)
4A4-10	Enteric fermentation - other animal	CH_4	40	Normal	IPCC (2006)
4B1-9, 4B13	Manure management	CH_4	25	Normal	IPCC (1997)
4B11-12	Manure management - N_2O	N_2O	Fac2	Lognormal	IPCC (1997)
4D1	Direct soil emission	N_2O	Fac5	Lognormal	IPCC (2000)
4D2	Animal production	N_2O	Fac2	Lognormal	IPCC (2000)
4D3	Indirect soil emission	N_2O	Fac3	Lognormal	IPCC (1997)
4F1	Agricultural residue burning	CH_4	Fac2	Lognormal	Expert judgement, Statistics Norway
4F1	Agricultural residue burning	N_2O	Fac3	Beta	Expert judgement, Statistics Norway
5A1	Forest Land remaining Forest Land, Fertilizer	N_2O	Fac5	Lognormal	NIJOS (2005)
5A1	Forest Land remaining Forest Land, Drainage	N_2O	Fac10	Lognormal	NIJOS (2005)
5A1	Forest Land remaining Forest Land, Wildfires	CH_4/ N_2O	75	Lognormal	NIJOS (2005)
5A1	Forest Land remaining Forest Land, Forest inventory area, Living Biomass	CO_2	15	Normal	NIJOS (2005)
5A1	Forest Land remaining Forest Land, Forest inventory area, Dead Biomass	CO_2	50	Lognormal	NIJOS (2005)
5A1	Forest Land remaining Forest Land, Forest inventory area, Soils, Mineral	CO_2	25	Normal	NIJOS (2005)
5A1	Forest Land remaining Forest Land, Forest inventory area, Soils, Organic	CO_2	Fac10	Lognormal	NIJOS (2005)
5A2	Land converted to Forest Land, Living biomass	CO_2	25	Normal	Expert judgement, Statistics Norway
5A2	Land converted to Forest Land, Soils, Mineral	CO_2	50	Lognormal	Expert judgement, Statistics Norway
5B1	Cropland remaining Cropland, Liming	CO_2	10	Normal	NIJOS (2005)

Annex II

IPCC Source category	Pollutant source	Gas	(2σ). per cent[1]	Density shape	Source/ comment
5B1	Cropland remaining Cropland, Horticulture, Living biomass	CO_2	25	Normal	NIJOS (2005)
5B1	Cropland remaining Cropland, Reduced tillage, Soils	CO_2	Fac2	Lognormal	NIJOS (2005)
5B1	Cropland remaining Cropland, Erosion of new agriculture land, Soils				
5B1	Cropland remaining Cropland, Histosols, Soils	CO_2	Fac3	Lognormal	NIJOS (2005)
5B2	Land converted to Cropland, Living biomass	CO_2	25	Normal	NIJOS (2005)
5B2	Land converted to Cropland, Soils, Mineral	CO_2	50	Lognormal	Expert judgement, Statistics Norway
5B2	Cropland, Disturbance	N_2O	Fac10	Lognormal	NIJOS (2005)
5C1	Grassland remaining Grassland, Other Grassland, Living biomass	CO_2	50	Lognormal	Expert judgement, Statistics Norway
5C1	Grassland remaining Grassland, Histosols, Soils	CO_2	Fac3	Lognormal	NIJOS (2005)
5C2	Cropland converted to Grassland, Horticulture, Living biomass	CO_2	25	Normal	NIJOS (2005)
5D1	Wetlands remaining Wetlands, Living biomass	CO_2	25	Normal	Expert judgement, Statistics Norway
5D1	Wetland remaining Wetland, Peat extraction, Soils	CO_2	Fac3	Lognormal	NIJOS (2005)
5D2	Land converted to Wetland, Drainage	N_2O	Fac10	Lognormal	NIJOS (2005)
5E2	Land converted to Settlements, Living biomass	CO_2	50	Lognormal	NIJOS (2005)
5E2	Land converted to Settlements, Soils	CO_2	50	Lognormal	Expert judgement, Statistics Norway
5F2	Land converted to Other land, Living biomass	CO_2	50	Lognormal	Expert judgement, Statistics Norway
5G	Other; Liming of lakes and rivers	CO_2	10	Normal	NIJOS (2005)
6A	Solid waste disposal	CH_4	30	Lognormal	SFT (2006a)
6B	Waste water treatment - CH_4	CH_4	50	Lognormal	IPCC (2000) and expert judgement, Statistics Norway (2010)[2]
6B	Waste water treatment - N_2O, pipeline and plant	N_2O	70	Lognormal	Expert judgement, Statistics Norway (2000)
6B	Waste water treatment - N_2O, not connected	N_2O	Fac5	Lognormal	IPCC (2006) and expert judgement, Statistics Norway (2010)
6C	Waste incineration	CO_2	30	Normal	Expert judgement, Statistics Norway
6C	Waste incineration	CH_4	Fac2	Lognormal	Expert judgement, Statistics Norway
6C	Waste incineration	N_2O	Fac3	Lognormal	Expert judgement, Statistics Norway

[1] Strongly skewed distributions are characterised as *fac2, fac3, fac5 and fac10*, indicating that 2σ is respectively a factor 2, 3, 5 and 10 below and above the mean.

[2] BOD/ person 30%, Bo 30% (IPCC 2000) and MCF 25%. Dependencies between parameters

Dependencies between parameters

Some of the input parameters (emission factors and activity data) are for various reasons not independent, that means that their values are dependent (or correlated). The problem of dependencies may be solved by appropriate aggregation of the data or explicitly by modelling. In this work we have partly designed the dataset to reduce the problem with dependencies as well as introduced a number of dependence assumptions into the model. The determination of dependencies is sometimes a difficult task and requires some understanding of the data set and the assumptions it is based on. Initial estimates with variable assumptions have shown that the assumptions on dependencies generally have little effect on the final conclusions on uncertainties. The assumptions of dependencies of data between years are, however, crucial for the determination of trend uncertainty (Statistics Norway 2000).

Dependencies between activity data

The activity data are in principle independent. However, the same activity data may be used to estimate more than one source category (e.g. in the agriculture sector). Also the same activity

data are used for estimating emissions of more than one pollutant (especially in the case of energy emissions).

The cases when activity data are assumed dependent in the statistical modelling are:

- The consumption of oil products in each sector. The sum of all oil products has a lower uncertainty than the consumption in each sector. In practice, this is treated by assuming that sectors are independent, and then by scaling all uncertainties so that total uncertainty equals a specified value.
- Where the same activity data are used to estimate emissions of more than one pollutant
- The number of domestic animals. The same population data are used for estimation of a) methane from enteric fermentation, b) methane and nitrous oxide from manure management and c) nitrous oxide from agricultural soils
- For estimation of N_2O from manure management, N_2O from manure spreading and N_2O from animal production (pasture) the following dependency estimation has been used for the activity data:
    - 70 % of emissions dependent on cattle population
    - 30 % of emissions dependent on sheep population
- For estimation of N_2O from indirect soil emissions the following dependency estimation has been used for the activity data:
    - 23 % of emissions dependent on cattle population
    - 10 % of emissions dependent on sheep population
    - 67 % of emissions dependent on amount of synthetic fertilizer used

Dependencies between emission factors

Where emission factors have been assumed equal, we have treated them as dependent in the analysis.

The following assumptions have been made:

- The CO_2 emission factors for each fuel type are dependent
- The methane and nitrous oxide emission factors from combustion are dependent where they have been assumed equal in the emission inventory model
- In a few cases the emission factors of different pollutants are correlated. That is in cases when CO_2 is oxidised from methane (oil extraction, loading and coal mining).
- For all direct emissions of N_2O from agricultural soils, except for N_2O from cultivation of organic soil, the same emission factor is being used, and the sources are dependent.
- There is a dependency between the emission factor used for calculating emissions from cropland liming and other liming.

There are also likely dependencies between other sources in LULUCF, e.g. between the activity data in the sources *5A2 Forest remaining forest* and *5Q1 Forest drainage*. But we have no estimates for the uncertainty in activity data, and anyhow the uncertainty in the emission factors is so large that even if the activity data is given an uncertainty it will have a minimal effect on the total uncertainty estimate for the source.

Dependencies between data in base year and end year

The estimates made for 1990 and 2009 will to a large extent be based on the same data and assumptions.

Activity data

The activity data are determined independently in the two years and are in principle not dependent. Correlation could be considered in cases where activity data cannot be updated annually or where updates are based on extrapolations or interpolations of data for another year.

This implies that we have assumed that errors in activity data are random, hence that systematic method errors are insignificant. It is, however, likely that there is a certain correlation between the activity data as they have been determined using the same methods.

Emission factors
Most of the emission factors are assumed unchanged from 1990 and 2009. Those that are not are all based on the same assumptions. This implies that all the emission factors are fully correlated between the two years.

This means that we have assumed that the emission factors assumed unchanged actually are unchanged from the base to end year. In reality it is expected that most emission factors are changing, but the degree of change is usually not known.

The statistical modelling
Uncertainty analysis based on probabilistic analysis implies that uncertainties in model inputs are used to propagate uncertainties in model outputs. The result of the uncertainty estimation gives us the range and likelihood of various output values (Cullen and Frey 1999).

Having generated a data set according to the specified parametric simultaneous distribution of the data described in table D1 and table D2, we may calculate any desired output defined as a function of the data. This gives us one simulated random realisation of this output, according to its marginal distribution derived from the underlying simultaneous distribution of the data. Independent repetition of the simulation gives an independent sample of the desired output according to its marginal distribution. The size of the sample is given by the number of repeated simulations, and has nothing to do with the size of the original data set. Based on such an independent and identically distributed sample, we may use the sample mean as an estimate of the mean of the output; we may also use the sample standard deviation as an estimate of the standard deviation of the output.

Results of the Tier 2 Uncertainty analysis
Results for the uncertainties in the total emissions and trends for the GHG inventory, excluding and including the LULUCF sector are given in Chapter 1.7.

Source category level used in the analysis

Source category level used in the analysis is listed in Table AII-3.

Table AII-3. Source category level used in the analysis

IPCC	Source Category	Pollutant source
1A1A	Public electricity and heat prod	Coal/coke combustion
1A1A	Public electricity and heat prod	Wood combustion
1A1A	Public electricity and heat prod	Gas combustion
1A1A	Public electricity and heat prod	Oil combustion
1A1A	Public electricity and heat prod	Waste combustion
1A1B	Petroleum refining	Coal/coke combustion
1A1B	Petroleum refining	Oil combustion
1A1C	Manufacture of solid fuels and other energy	Gas combustion
1A1C	Manufacture of solid fuels and other energy	Oil combustion
1A2A	Iron and steel	Coal/coke combustion
1A2A	Iron and steel	Wood combustion
1A2A	Iron and steel	Gas combustion
1A2A	Iron and steel	Oil combustion
1A2B	Non-ferrous metal	Coal/coke combustion
1A2B	Non-ferrous metal	Wood combustion
1A2B	Non-ferrous metal	Gas combustion
1A2B	Non-ferrous metal	Oil combustion
1A2C	Chemicals	Coal/coke combustion
1A2C	Chemicals	Wood combustion
1A2C	Chemicals	Gas combustion
1A2C	Chemicals	Oil combustion
1A2D	Pulp, paper, print	Coal/coke combustion
1A2D	Pulp, paper, print	Wood combustion
1A2D	Pulp, paper, print	Gas combustion
1A2D	Pulp, paper, print	Oil combustion
1A2E	Food processing, beverages, tobacco	Coal/coke combustion
1A2E	Food processing, beverages, tobacco	Wood combustion
1A2E	Food processing, beverages, tobacco	Gas combustion
1A2E	Food processing, beverages, tobacco	Oil combustion
1A2F	Other manufacturing	Coal/coke combustion
1A2F	Other manufacturing	Wood combustion
1A2F	Other manufacturing	Gas combustion
1A2F	Other manufacturing	Oil combustion
1A2F	Other manufacturing	Waste combustion
1A3A	Transport fuel - civil aviation	
1A3B	Transport fuel - road transportation	
1A3C	Transport fuel - railway	
1A3D	Transport fuel - navigation	
1A3E	Transport fuel - motorized equipment and pipeline	
1A4A	Commercial/institutional	Coal/coke combustion
1A4A	Commercial/institutional	Wood combustion
1A4A	Commercial/institutional	Gas combustion
1A4A	Commercial/institutional	Oil combustion
1A4A	Commercial/institutional	Waste combustion
1A4B	Residential	Coal/coke combustion
1A4B	Residential	Wood combustion
1A4B	Residential	Gas combustion
1A4B	Residential	Oil combustion
1A4C	Agriculture/forestry/fishing	Coal/coke combustion
1A4C	Agriculture/forestry/fishing	Wood combustion
1A4C	Agriculture/forestry/fishing	Gas combustion
1A4C	Agriculture/forestry/fishing	Oil combustion
1A5A	Military	Military fuel - stationary
1A5B	Military	Military fuel - mobile
1B1A	Coal mining, Extraction of natural gas	
1B2A	Extraction of oil - transport	
1B2A	Extraction of oil - refining/storage	
1B2A	Extraction of oil - distribution gasoline	
1B2B	Coal mining, Extraction of natural gas	
1B2C	Venting	
1B2C	Well testing	
1B2C	Flaring	
2A1	Cement production	
2A2	Lime production	
2A3	Limestone and dolomite use	
2A7	Other mineral production	
2B1	Ammonia production	

Annex II

IPCC	Source Category	Pollutant source
2B2	Nitric acid production	
2B4	Silicium carbide production	
2B4	Calcium carbide production	
2B5	Methanol and plastic production	
2C1	Iron and steel production	
2C2	Ferroalloys production	
2C3	Aluminium production	
2C4	SF6 used in Al and Mg foundries	
2C5	Mg production	
2C5	Ni production, anodes	
2D1	Pulp and paper	
2D2	Carbonic acid, bio protein	
2F	consumption of halocarbons and SF_6	
3A	Paint application	
3B	Degreasing and dry cleaning	
3C	Chemical products, Manufacture and processing	
3D	Other	
4A1	Enteric fermentation - cattle	
4A10	Enteric fermentation - other animal	
4A3	Enteric fermentation – sheep	
4A4	Enteric fermentation – goat	
4A6	Enteric fermentation – horse	
4A8	Enteric fermentation – swine	
4A9	Enteric fermentation – poultry	
4B1	Manure management - CH_4 – cattle	
4B11	Manure management - N_2O - Liquid storage	
4B12	Manure management - N_2O - solid storage	
4B13	Manure management - CH_4 - other animal	
4B3	Manure management - CH_4 – sheep	
4B4	Manure management - CH_4 – goat	
4B6	Manure management - CH_4 - horse	
4B8	Manure management - CH_4 - swine	
4B9	Manure management - CH_4 - poultry	
4D1	Direct soil emission – Fertilizer	
4D1	Direct soil emission – Manure	
4D1	Direct soil emission- Other	
4D1	Direct soil emission- Organic soil	
4D2	Animal production	
4D3	Indirect soil emission- Deposition	
4D3	Indirect soil emission - Leaching, other	
4F1	Burning of straw	
5A1	Forest Land remaining Forest Land, Fertilizer	
5A1	Forest Land remaining Forest Land, Drainage	
5A1	Forest Land remaining Forest Land, Wildfires	
5A1	Forest Land remaining Forest Land, Forest inventory area, Living Biomass	
5A1	Forest Land remaining Forest Land, Forest inventory area, Dead Biomass	
5A1	Forest Land remaining Forest Land, Forest inventory area, Soils, Mineral	
5A1	Forest Land remaining Forest Land, Forest inventory area, Soils, Organic	
5A2	Land converted to Forest Land, Living biomass	
5A2	Land converted to Forest Land, Soils, Mineral	
5B1	Cropland remaining Cropland, Liming	
5B1	Cropland remaining Cropland, Horticulture, Living biomass	
5B1	Cropland remaining Cropland, Reduced tillage, Soils	
5B1	Cropland remaining Cropland, Erosion of new agriculture land, Soils	
5B1	Cropland remaining Cropland, Histosols, Soils	
5B2	Land converted to Cropland, Living biomass	
5B2	Land converted to Cropland, Soils, Mineral	
5B2	Cropland, Disturbance	
5C1	Grassland remaining Grassland, Other Grassland, Living biomass	
5C1	Grassland remaining Grassland, Histosols, Soils	
5C2	Cropland converted to Grassland, Horticulture, Living biomass	
5D1	Wetlands remaining Wetlands, Living biomass	
5D1	Wetland remaining Wetland, Peat extraction, Soils	
5D2	Land converted to Wetland, Drainage	
5E2	Land converted to Settlements, Living biomass	
5E2	Land converted to Settlements, Soils	

Annex II

IPCC	Source Category	Pollutant source
5F2	Land converted to Other land, Living biomass	
5G	Other; Liming of lakes and rivers	
6A	Managed waste disposal on land	
6B	Waste water -CH_4	
6B	Waste water - N_2O pipeline	
6B	Waste water - N_2O plant	
6B	Waste water - N_2O not connected	
6C	Waste incineration	

Table AII-4: Table 6.2 in the GPG. Tier 2 uncertainty reporting.

	A	A*	B	C	D	E	F	G	H	I	J
	IPCC Source category		**Gas**	**Base year emissions**	**Year t emissions**	**Uncertainty in year t emissions as % of emissions in the category**		**Uncertainty introduced on national total in year t**	**% change in emissions between year t and base year**	**Range of likely % change between year t and base year**	
Source		**Subcategory**		**Gg CO_2 equivalent**	**Gg CO_2 equivalent**	**% below (2.5 percentile)**	**% above (97.5 percentile)**	**%**	**%**	**Lower % (2.5 percentile)**	**Upper % (97.5 percentile)**
Total	Total			41,203	25,964				-37%		
1A1A_VT1	Coal/coke combustion	Public electricity and heat prod	CO2	205	112	-9	8	0.037	-45	-49	-41
1A1A_VT3	Gas combustion	Public electricity and heat prod	CO2	-	1,119	-1	1	0.046	…	-	-
1A1A_VT6	Oil combustion	Public electricity and heat prod	CO2	14	110	-4	4	0.017	662	635	686
1A1A_VT7	Waste combustion	Public electricity and heat prod	CO2	97	429	-28	29	**0.499**	344	314	378
1A1B_VT1	Coal/coke combustion	Petroleum refining	CO2	161	247	-1	2	0.014	53	51	56
1A1B_VT6	Oil combustion	Petroleum refining	CO2	793	767	-1	1	0.042	-3	-5	-2
1A1C_VT3	Gas combustion	Manufacture of solid fuels and other energy	CO2	5,185	10,541	-2	3	**1.052**	103	103	104
1A1C_VT6	Oil combustion	Manufacture of solid fuels and other energy	CO2	251	788	-3	3	0.101	213	207	220
1A2A_VT1	Coal/coke combustion	Iron and steel	CO2	60	12	-17	17	0.008	-79	-81	-78
1A2A_VT3	Gas combustion	Iron and steel	CO2	-	3	-5	5	0.001	…	-	-
1A2A_VT6	Oil combustion	Iron and steel	CO2	45	59	-3	3	0.007	31	30	32
1A2B_VT1	Coal/coke combustion	Non-ferrous metal	CO2	0	-	...	...	-	-100	-100	-100
1A2B_VT3	Gas combustion	Non-ferrous metal	CO2	-	104	-5	6	0.022	…	-	-
1A2B_VT6	Oil combustion	Non-ferrous metal	CO2	268	83	-4	4	0.013	-69	-70	-68
1A2C_VT1	Coal/coke combustion	Chemicals	CO2	133	110	-8	8	0.036	-17	-23	-11

	A	A*	B	C	D	E	F	G	H		I	J
	IPCC Source category		Gas	Base year emissions	Year t emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year t	% change in emissions between year t and base year		Range of likely % change between year t and base year	
Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%		Lower % (2.5 percentile)	Upper % (97.5 percentile)
1A2C_VT3	Gas combustion	Chemicals	CO2	-	369	-2	2	0.032	…		-	-
1A2C_VT6	Oil combustion	Chemicals	CO2	1,064	837	-14	15	0.468		-21	-36	-4
1A2D_VT1	Coal/coke combustion	Pulp, paper, print	CO2	16	-	...	...	-		-100	-100	-100
1A2D_VT3	Gas combustion	Pulp, paper, print	CO2	-	3	-4	4	0.000	…		-	-
1A2D_VT6	Oil combustion	Pulp, paper, print	CO2	210	336	-3	3	0.039		60	58	61
1A2E_VT1	Coal/coke combustion	Food prosessing, beverages, tobacco	CO2	10	-	...	...	-		-100	-100	-100
1A2E_VT3	Gas combustion	Food prosessing, beverages, tobacco	CO2	-	89	-5	5	0.018	…		-	-
1A2E_VT6	Oil combustion	Food prosessing, beverages, tobacco	CO2	456	237	-4	4	0.036		-48	-50	-46
1A2F_VT1	Coal/coke combustion	Other manufacturing	CO2	396	335	-2	2	0.029		-16	-16	-15
1A2F_VT3	Gas combustion	Other manufacturing	CO2	-	69	-6	5	0.015	…		-	-
1A2F_VT6	Oil combustion	Other manufacturing	CO2	1,135	815	-4	4	0.118		-28	-30	-26
1A2F_VT7	Waste combustion	Other manufacturing	CO2	-	47	-25	25	0.047	…		-	-
1A3A	Transport fuel - civil aviation		CO2	679	1,071	-16	17	**0.700**		58	25	104
1A3B	Transport fuel - road transportation		CO2	7,630	9,697	-5	5	**1.872**		27	20	34
1A3C	Transport fuel - railway		CO2	96	45	-5	5	0.009		-53	-56	-50
1A3D	Transport fuel - navigation		CO2	1,696	2,001	-16	17	**1.310**		18	-7	50
1A3E	Transport fuel - motorized equipment and pipeline		CO2	760	1,211	-15	16	**0.773**		59	24	102
1A4A_VT1	Coal/coke combustion	Commercial/institutional	CO2	-	5	-19	21	0.004	…		-	-
1A4A_VT3	Gas combustion	Commercial/institutional	CO2	-	50	-10	10	0.020	…		-	-
1A4A_VT6	Oil combustion	Commercial/institutional	CO2	812	734	-16	17	**0.496**		-10	-29	15

	A	A*	B	C	D	E	F	G	H	I	J
	IPCC Source category		Gas	Base year emissions	Year t emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year t	% change in emissions between year t and base year	Range of likely % change between year t and base year	
Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
1A4A_VT7	Waste combustion	Commercial/institutional	CO2	3	-	...	...	-	-100	-100	-100
1A4B_VT1	Coal/coke combustion	Residential	CO2	24	2	-21	22	0.001	-93	-95	-91
1A4B_VT3	Gas combustion	Residential	CO2	-	8	-27	30	0.009	…	-	-
1A4B_VT6	Oil combustion	Residential	CO2	1,318	454	-8	9	0.150	-66	-69	-61
1A4C_VT1	Coal/coke combustion	Agriculture/forestry/fishing	CO2	12	-	...	...	-	-100	-100	-100
1A4C_VT3	Gas combustion	Agriculture/forestry/fishing	CO2	-	42	-31	29	0.050	…	-	-
1A4C_VT6	Oil combustion	Agriculture/forestry/fishing	CO2	1,975	1,883	-8	9	**0.646**	-5	-15	7
1A5A	Military fuel - stationary	Military	CO2	62	35	-7	7	0.010	-44	-48	-40
1A5B	Military fuel - mobile	Military	CO2	394	228	-7	7	0.063	-42	-46	-38
1B1A	Coal mining, Extraction of natural gas		CO2	7	5	-51	93	0.013	-38	-40	-35
1B2A_x	Extraction of oil - transport		CO2	367	124	-34	50	**0.199**	-66	-68	-65
1B2A_y	Extraction of oil - refining/storage		CO2	749	873	-32	44	**1.343**	17	12	22
1B2A_z	Extraction of oil - distribution gasoline		CO2	30	14	-35	44	0.023	-52	-55	-50
1B2B	Coal mining, Extraction of natural gas		CO2	4	13	-51	84	0.034	211	198	225
1B2C_x	Venting		CO2	27	117	-52	86	0.319	332	332	332
1B2C_z	Well testing		CO2	80	20	-31	30	0.024	-75	-84	-61
1B2C_y	Flaring		CO2	1,393	1,266	-4	5	0.233	-9	-11	-7
2A1	Cement production		CO2	634	842	-1	1	0.024	33	32	34
2A2	Lime production		CO2	47	137	-1	1	0.003	194	192	195
2A3	Limestone and dolomite use		CO2	24	31	-15	15	0.019	30	6	57
2A7	Other mineral production		CO2	2	2	-7	7	0.001	-15	-15	-15

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Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
2B1	Ammonia production		CO2	500	335	-8	7	0.098	-33	-36	-30
2B4_x	Silicium carbide production		CO2	222	51	-10	10	0.021	-77	-78	-76
2B4_y	Calcium carbide production		CO2	178	-	...	...	-	-100	-100	-100
2B5	Methanol and plastic production		CO2	3	95	-8	9	0.033	3,516	3,080	3,968
2C1	Iron and steel production		CO2	213	270	-2	2	0.019	27	25	29
2C2	Ferroalloys production		CO2	2,554	1,446	-3	3	0.171	-43	-43	-43
2C3	Aluminium production		CO2	1,419	1,725	-10	11	**0.718**	22	17	27
2C5_x	Mg production		CO2	128	-	...	...	-	-100	-100	-100
2C5_y	Ni production, anodes		CO2	26	95	-14	14	0.053	270	221	322
2D1	Pulp and paper		CO2	10	9	-10	9	0.003	-14	-15	-13
2D2	Carbonic acid, bio protein		CO2	67	172	-13	14	0.093	157	123	196
3A	Paint application		CO2	39	17	-10	9	0.007	-56	-56	-56
3B	Degreasing and dry cleaning		CO2	-	1	-10	10	0.000	…	-	-
3C	Chemical products, Manufaqcture and processing		CO2	8	1	-10	10	0.000	-89	-89	-89
3D	Other		CO2	100	96	-10	10	0.038	-4	-4	-4
5A1-1	Forest Land remaining Forest Land, Forest inventory area, Living Biomass		CO2	-6,413	-22,172	15	-13	12.691	246	246	246
5A1-2	Forest Land remaining Forest Land, Forest inventory area, Dead Biomass		CO2	-2,042	-1,002	49	-49	1.986	-51	-51	-51

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	IPCC Source category		Gas	Base year emissions	Year t emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year t	% change in emissions between year t and base year	Range of likely % change between year t and base year	
Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
5A1-4	Forest Land remaining Forest Land, Forest inventory area, Soils, Mineral		CO2	-3,056	-4,584	24	-25	4.510	50	50	50
5A1-3	Forest Land remaining Forest Land, Forest inventory area, Soils, Organic		CO2	136	144	-103	100	0.585	6	6	6
5A2-BM	Land converted to Forest Land, Living biomass		CO2	-5	-365	26	-24	0.358	6,740	6,740	6,740
5A2-S	Land converted to Forest Land, Soils, Mineral		CO2	30	71	-50	51	0.139	136	136	136
5B-IV	Cropland remaining Cropland, Liming		CO2	217	83	-11	12	0.036	-62	-64	-59
5B1-1	Cropland remaining Cropland, Horticulture, Living biomass		CO2	-24	-18	24	-25	0.018	-23	-23	-23
5B1-3	Cropland remaining Cropland, Reduced tillage, Soils		CO2	-	-180	55	-57	0.398	…	-	-
5B1-5	Cropland remaining Cropland, Erosion of new agriculture land, Soils		CO2	6	1	0	0	-	-86	-86	-86
5B1-4	Cropland remaining Cropland, Histosols, Soils		CO2	208	208	-81	80	0.659	-	-	-
5B2-BM	Land converted to Cropland, Living biomass		CO2	52	-2	25	-24	0.002	-104	-104	-104

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	IPCC Source category		Gas	Base year emissions	Year t emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year t	% change in emissions between year t and base year	Range of likely % change between year t and base year	
Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
5B2-S	Land converted to Cropland, Soils, Mineral		CO2	1	28	-49	46	0.055	1,807	1,807	1,807
5C1-1	Grassland remaining Grassland, Other Grassland, Living biomass		CO2	126	-	...	...	-	-100	-100	-100
5C1-2	Grassland remaining Grassland, Histosols, Soils		CO2	1,870	1,870	-84	81	5.790	-	-	-
5D1-2	Wetland remaining Wetland, Peat extraction, Soils		CO2	3	3	-79	74	0.010	-	-	-
5E2-BM	Land converted to Settlements, Living biomass		CO2	271	299	-49	46	0.556	11	11	11
5E2-S	Land converted to Settlements, Soils		CO2	39	259	-47	46	0.482	570	570	570
5F2	Land converted to Other land, Living biomass		CO2	-	-4	46	-50	0.008	…	-	-
5G-IV	Other; Liming of lakes and rivers		CO2	10	17	-10	12	0.007	64	54	77
6C	Waste incineration		CO2	0	-	...	...	-	-100	-100	-100
1A1A_VT1	Coal/coke combustion	Public electricity and heat prod	CH4	0	0	-55	89	0.000	-33	-37	-28
1A1A_VT2	Wood combustion	Public electricity and heat prod	CH4	0	2	-56	101	0.005	244	131	415
1A1A_VT3	Gas combustion	Public electricity and heat prod	CH4	-	9	-51	99	0.027	…	-	-
1A1A_VT6	Oil combustion	Public electricity and heat prod	CH4	0	0	-61	56	0.000	742	712	768

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Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
1A1A_VT7	Waste combustion	Public electricity and heat prod	CH4	2	4	-54	87	0.011	106	92	121
1A1B_VT6	Oil combustion	Petroleum refining	CH4	5	1	-58	61	0.002	-86	-86	-86
1A1C_VT3	Gas combustion	Manufacture of solid fuels and other energy	CH4	41	82	-53	82	0.223	101	100	101
1A1C_VT6	Oil combustion	Manufacture of solid fuels and other energy	CH4	0	0	-61	56	0.000	-100	-100	-100
1A2A_VT1	Coal/coke combustion	Iron and steel	CH4	0	0	-55	90	0.000	-53	-56	-51
1A2A_VT2	Wood combustion	Iron and steel	CH4	0	0	-59	97	0.000	269	144	453
1A2A_VT3	Gas combustion	Iron and steel	CH4	-	0	-54	84	0.000	…	-	-
1A2A_VT6	Oil combustion	Iron and steel	CH4	0	0	-61	56	0.000	-22	-22	-21
1A2B_VT2	Wood combustion	Non-ferrous metal	CH4	-	0	-55	108	0.000	…	-	-
1A2B_VT3	Gas combustion	Non-ferrous metal	CH4	-	0	-52	92	0.000	…	-	-
1A2B_VT6	Oil combustion	Non-ferrous metal	CH4	0	0	-62	57	0.000	-39	-41	-37
1A2C_VT1	Coal/coke combustion	Chemicals	CH4	0	0	-55	90	0.000	-11	-17	-4
1A2C_VT2	Wood combustion	Chemicals	CH4	0	0	-58	98	0.001	295	166	519
1A2C_VT3	Gas combustion	Chemicals	CH4	-	0	-52	94	0.001	…	-	-
1A2C_VT6	Oil combustion	Chemicals	CH4	1	1	-60	66	0.003	-6	-23	15
1A2D_VT1	Coal/coke combustion	Pulp, paper, print	CH4	0	-	...	...	-	-100	-100	-100
1A2D_VT2	Wood combustion	Pulp, paper, print	CH4	6	5	-57	99	0.015	-17	-45	30
1A2D_VT3	Gas combustion	Pulp, paper, print	CH4	-	0	-53	77	0.000	…	-	-
1A2D_VT6	Oil combustion	Pulp, paper, print	CH4	0	0	-61	56	0.000	107	105	108
1A2E_VT1	Coal/coke combustion	Food prosessing, beverages, tobacco	CH4	0	-	...	...	-	-100	-100	-100

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Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
1A2E_VT2	Wood combustion	Food prosessing, beverages, tobacco	CH4	0	0	-57	97	0.000	-96	-97	-93
1A2E_VT3	Gas combustion	Food prosessing, beverages, tobacco	CH4	-	0	-53	88	0.001	…	-	-
1A2E_VT6	Oil combustion	Food prosessing, beverages, tobacco	CH4	0	0	-62	56	0.000	-41	-43	-39
1A2F_VT1	Coal/coke combustion	Other manufacturing	CH4	0	0	-54	90	0.001	22	21	23
1A2F_VT2	Wood combustion	Other manufacturing	CH4	1	1	-57	93	0.003	-29	-52	9
1A2F_VT3	Gas combustion	Other manufacturing	CH4	-	0	-53	88	0.000	…	-	-
1A2F_VT6	Oil combustion	Other manufacturing	CH4	2	2	-61	55	0.004	-5	-8	-2
1A2F_VT7	Waste combustion	Other manufacturing	CH4	-	1	-53	86	0.001	…	-	-
1A3A	Transport fuel - civil aviation		CH4	0	1	-53	90	0.002	86	47	140
1A3B	Transport fuel - road transportation		CH4	71	18	-35	49	0.031	-75	-76	-73
1A3C	Transport fuel - railway		CH4	0	0	-54	85	0.000	-53	-56	-50
1A3D	Transport fuel - navigation		CH4	4	52	-54	90	0.145	1,061	816	1,374
1A3E	Transport fuel - motorized equipment and pipeline		CH4	7	9	-53	87	0.027	33	4	70
1A4A_VT1	Coal/coke combustion	Commercial/institutional	CH4	-	0	-52	84	0.000	…	-	-
1A4A_VT2	Wood combustion	Commercial/institutional	CH4	0	0	-56	93	0.001	9,944	6,531	15,274
1A4A_VT3	Gas combustion	Commercial/institutional	CH4	-	0	-51	87	0.000	…	-	-
1A4A_VT6	Oil combustion	Commercial/institutional	CH4	2	2	-58	68	0.005	-11	-30	13
1A4A_VT7	Waste combustion	Commercial/institutional	CH4	0	-	...	...	-	-100	-100	-100
1A4B_VT1	Coal/coke combustion	Residential	CH4	2	0	-55	83	0.000	-94	-95	-91
1A4B_VT2	Wood combustion	Residential	CH4	111	142	-54	104	0.446	27	-12	90

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Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
1A4B_VT3	Gas combustion	Residential	CH4	-	0	-55	98	0.000	…	-	-
1A4B_VT6	Oil combustion	Residential	CH4	3	1	-58	65	0.003	-66	-70	-61
1A4C_VT1	Coal/coke combustion	Agriculture/forestry/fishing	CH4	0	-	...	...	-	-100	-100	-100
1A4C_VT2	Wood combustion	Agriculture/forestry/fishing	CH4	-	0	-58	105	0.000	…	-	-
1A4C_VT3	Gas combustion	Agriculture/forestry/fishing	CH4	-	0	-53	96	0.000	…	-	-
1A4C_VT6	Oil combustion	Agriculture/forestry/fishing	CH4	4	3	-57	64	0.008	-16	-25	-5
1A5A	Military fuel - stationary	Military	CH4	0	0	-52	95	0.000	-29	-34	-24
1A5B	Military fuel - mobile	Military	CH4	0	0	-50	88	0.001	-36	-41	-32
1B1A	Coal mining, Extraction of natural gas		CH4	56	35	-51	93	0.098	-38	-40	-35
1B2A_x	Extraction of oil - transport		CH4	129	153	-34	50	0.246	18	14	23
1B2A_y	Extraction of oil - refining/storage		CH4	35	48	-33	41	0.072	36	31	42
1B2B	Coal mining, Extraction of natural gas		CH4	3	47	-50	85	0.124	1,753	1,680	1,837
1B2C_x	Venting		CH4	143	331	-52	86	**0.904**	131	131	131
1B2C_z	Well testing		CH4	0	0	-60	68	0.000	-75	-84	-61
1B2C_y	Flaring		CH4	10	14	-60	53	0.031	40	37	43
2B4_x	Silicium carbide production		CH4	7	2	-11	10	0.001	-77	-78	-76
2B5	Methanol and plastic production		CH4	2	3	-53	83	0.008	74	53	96
2C2	Ferroalloys production		CH4	1	1	-51	85	0.002	-23	-23	-23
4A1	Enteric fermentation - cattle		CH4	1,420	1,268	-23	24	**1.194**	-11	-16	-4
4A10	Enteric fermentation - other animal		CH4	102	111	-40	40	0.171	9	2	17
4A3	Enteric fermentation - sheep		CH4	431	461	-24	24	0.458	7	-0	14

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Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
4A4	Enteric fermentation - goat		CH4	9	7	-39	40	0.011	-24	-29	-19
4A6	Enteric fermentation - horse		CH4	12	25	-40	38	0.039	109	97	124
4A8	Enteric fermentation - swine		CH4	17	22	-38	40	0.035	32	23	42
4A9	Enteric fermentation - poultry		CH4	1	2	-40	37	0.003	49	39	59
4B1	Manure management - CH4 -cattle		CH4	215	194	-25	25	0.187	-10	-15	-3
4B13	Manure management - CH4 - other animal		CH4	4	5	-24	25	0.005	19	11	28
4B3	Manure management - CH4 - sheep		CH4	24	24	-23	25	0.024	0	-6	7
4B4	Manure management - CH4 -goat		CH4	2	1	-24	26	0.001	-31	-35	-26
4B6	Manure management - CH4- horse		CH4	11	23	-25	26	0.023	109	97	124
4B8	Manure management - CH4- swine		CH4	23	29	-26	23	0.028	30	21	39
4B9	Manure management - CH4- poultry		CH4	19	37	-26	25	0.036	97	83	110
4F1	Burning of straw		CH4	23	3	-54	87	0.010	-85	-87	-83
5A1-V	Forest Land remaining Forest Land, Wildfires		CH4	2	3	-54	100	0.008	42	8	92
6A	Managed waste disposal on land		CH4	1,682	1,065	-31	38	**1.457**	-37	-52	-17
6B_x	Waste water - CH4		CH4	20	10	-39	57	0.018	-50	-50	-49
6C	Waste incineration		CH4	0	0	-55	93	0.000	522	304	869

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Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
1A1A_VT1	Coal/coke combustion	Public electricity and heat prod	N2O	1	1	-74	105	0.002	-46	-50	-42
1A1A_VT2	Wood combustion	Public electricity and heat prod	N2O	2	5	-74	125	0.019	162	76	292
1A1A_VT3	Gas combustion	Public electricity and heat prod	N2O	-	3	-73	116	0.011	…	-	-
1A1A_VT6	Oil combustion	Public electricity and heat prod	N2O	0	0	-71	109	0.001	528	506	548
1A1A_VT7	Waste combustion	Public electricity and heat prod	N2O	4	6	-74	123	0.026	54	43	65
1A1B_VT1	Coal/coke combustion	Petroleum refining	N2O	0	0	-72	121	0.002	53	51	56
1A1B_VT6	Oil combustion	Petroleum refining	N2O	5	2	-73	121	0.009	-57	-57	-56
1A1C_VT3	Gas combustion	Manufacture of solid fuels and other energy	N2O	14	27	-74	121	0.107	101	101	102
1A1C_VT6	Oil combustion	Manufacture of solid fuels and other energy	N2O	1	2	-71	107	0.007	181	176	187
1A2A_VT1	Coal/coke combustion	Iron and steel	N2O	0	0	-72	116	0.001	-53	-56	-51
1A2A_VT2	Wood combustion	Iron and steel	N2O	0	0	-74	114	0.000	269	144	453
1A2A_VT3	Gas combustion	Iron and steel	N2O	-	0	-74	117	0.000	…	-	-
1A2A_VT6	Oil combustion	Iron and steel	N2O	0	0	-70	107	0.000	-57	-58	-57
1A2B_VT2	Wood combustion	Non-ferrous metal	N2O	-	0	-75	134	0.001	…	-	-
1A2B_VT3	Gas combustion	Non-ferrous metal	N2O	-	0	-69	128	0.001	…	-	-
1A2B_VT6	Oil combustion	Non-ferrous metal	N2O	1	0	-70	107	0.001	-71	-72	-69
1A2C_VT1	Coal/coke combustion	Chemicals	N2O	1	1	-72	115	0.002	-11	-17	-4
1A2C_VT2	Wood combustion	Chemicals	N2O	0	1	-74	124	0.003	295	166	519

	A	A*	B	C	D	E	F	G	H	I	J
	IPCC Source category		Gas	Base year emissions	Year t emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year t	% change in emissions between year t and base year	Range of likely % change between year t and base year	
Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
1A2C_VT3	Gas combustion	Chemicals	N2O	-	0	-72	116	0.001	…	-	-
1A2C_VT6	Oil combustion	Chemicals	N2O	1	2	-71	125	0.008	64	33	100
1A2D_VT1	Coal/coke combustion	Pulp, paper, print	N2O	0	-	...	...	-	-100	-100	-100
1A2D_VT2	Wood combustion	Pulp, paper, print	N2O	27	20	-75	132	0.078	-28	-52	13
1A2D_VT3	Gas combustion	Pulp, paper, print	N2O	-	0	-70	120	0.000	…	-	-
1A2D_VT6	Oil combustion	Pulp, paper, print	N2O	1	1	-70	107	0.004	56	55	57
1A2E_VT1	Coal/coke combustion	Food prosessing, beverages, tobacco	N2O	0	-	...	...	-	-100	-100	-100
1A2E_VT2	Wood combustion	Food prosessing, beverages, tobacco	N2O	0	0	-76	125	0.000	-96	-97	-93
1A2E_VT3	Gas combustion	Food prosessing, beverages, tobacco	N2O	-	0	-71	115	0.000	…	-	-
1A2E_VT6	Oil combustion	Food prosessing, beverages, tobacco	N2O	1	1	-71	106	0.003	-47	-49	-45
1A2F_VT1	Coal/coke combustion	Other manufacturing	N2O	0	0	-72	119	0.001	146	143	148
1A2F_VT2	Wood combustion	Other manufacturing	N2O	6	4	-75	123	0.017	-29	-52	9
1A2F_VT3	Gas combustion	Other manufacturing	N2O	-	0	-73	115	0.000	…	-	-
1A2F_VT6	Oil combustion	Other manufacturing	N2O	3	2	-71	108	0.008	-28	-30	-25
1A2F_VT7	Waste combustion	Other manufacturing	N2O	-	1	-71	118	0.004	…	-	-
1A3A	Transport fuel - civil aviation		N2O	7	11	-74	113	0.041	58	25	104
1A3B	Transport fuel - road transportation		N2O	57	59	-51	70	**0.146**	5	-2	10
1A3C	Transport fuel - railway		N2O	11	5	-84	99	0.020	-53	-56	-50
1A3D	Transport fuel - navigation		N2O	11	14	-73	129	0.058	30	3	65

	A	A*	B	C	D	E	F	G	H	I	J
	IPCC Source category		Gas	Base year emissions	Year t emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year t	% change in emissions between year t and base year	Range of likely % change between year t and base year	
Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
1A3E	Transport fuel - motorized equipment and pipeline		N2O	69	125	-77	110	0.487	81	41	130
1A4A_VT1	Coal/coke combustion	Commercial/institutional	N2O	-	0	-72	128	0.000	…	-	-
1A4A_VT2	Wood combustion	Commercial/institutional	N2O	0	0	-74	136	0.002	4,429	2,890	6,832
1A4A_VT3	Gas combustion	Commercial/institutional	N2O	-	0	-73	118	0.000	…	-	-
1A4A_VT6	Oil combustion	Commercial/institutional	N2O	2	2	-72	113	0.008	-10	-29	15
1A4A_VT7	Waste combustion	Commercial/institutional	N2O	0	-	...	...	-	-100	-100	-100
1A4B_VT1	Coal/coke combustion	Residential	N2O	0	0	-72	127	0.000	-94	-95	-91
1A4B_VT2	Wood combustion	Residential	N2O	10	13	-73	130	0.051	29	-11	92
1A4B_VT3	Gas combustion	Residential	N2O	-	0	-75	129	0.000	…	-	-
1A4B_VT6	Oil combustion	Residential	N2O	4	1	-71	110	0.005	-65	-69	-61
1A4C_VT1	Coal/coke combustion	Agriculture/forestry/fishing	N2O	0	-	...	...	-	-100	-100	-100
1A4C_VT2	Wood combustion	Agriculture/forestry/fishing	N2O	-	0	-74	118	0.000	…	-	-
1A4C_VT3	Gas combustion	Agriculture/forestry/fishing	N2O	-	0	-72	120	0.000	…	-	-
1A4C_VT6	Oil combustion	Agriculture/forestry/fishing	N2O	67	61	-71	112	0.231	-9	-19	2
1A5A	Military fuel - stationary	Military	N2O	0	0	-73	114	0.001	21	13	30
1A5B	Military fuel - mobile	Military	N2O	6	4	-76	104	0.015	-31	-36	-27
1B2C_z	Well testing		N2O	0	0	-74	136	0.000	-75	-84	-61
1B2C_y	Flaring		N2O	4	4	-75	112	0.013	-15	-16	-13
2B2	Nitric acid production		N2O	2,074	460	-6	6	0.108	-78	-78	-78
2B5	Methanol and plastic production		N2O	-	1	-9	9	0.000	…	-	-
2C2	Ferroalloys production		N2O	5	4	-10	10	0.001	-28	-28	-28
3D	Other		N2O	36	44	-15	15	0.026	25	25	25

	A	A*	B	C	D	E	F	G	H	I	J
	IPCC Source category		Gas	Base year emissions	Year t emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year t	% change in emissions between year t and base year	Range of likely % change between year t and base year	
Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
4B11	Manure management - N2O - Liquid storage		N2O	17	18	-53	80	0.047	1	-5	6
4B12	Manure management - N2O - solid storage		N2O	116	109	-52	84	0.290	-6	-11	-1
4D1_x	Direct soil emission - Fertilizer		N2O	665	595	-82	220	**3.633**	-11	-16	-4
4D1_y	Direct soil emission - Manure		N2O	240	232	-82	219	**1.417**	-4	-9	1
4D1_xx	Direct soil emission- Other		N2O	160	138	-84	245	**0.944**	-13	-63	109
4D1_z	Direct soil emission- Organic soil		N2O	332	287	-86	228	**1.961**	-14	-68	120
4D2	Animal production		N2O	223	206	-54	84	**0.569**	-8	-13	-3
4D3_x	Indirect soil emission- Deposition		N2O	71	82	-70	142	0.345	15	10	21
4D3_y	Indirect soil emission - Leaching, other		N2O	346	322	-69	170	**1.496**	-7	-11	-3
4F1	Burning of straw		N2O	9	1	-70	112	0.005	-85	-87	-83
5A2-I	Forest Land remaining Forest Land, Fertilizer		N2O	1	1	-83	219	0.004	-58	-58	-58
5A-II	Forest Land remaining Forest Land, Drainage		N2O	11	12	-87	317	0.111	6	6	6
5A1-V	Forest Land remaining Forest Land, Wildfires		N2O	0	0	-55	95	0.001	42	8	92
5B2-III	Cropland, Disturbance		N2O	1	0	-90	328	0.001	-86	-86	-86
5D-II	Land converted to Wetland, Drainage		N2O	0	0	-89	309	0.001	-	-	-
6B_z	Waste water - N2O plant		N2O	-	37	-55	88	0.109	…	-	-

	A	A*	B	C	D	E	F	G	H	I	J
	IPCC Source category		Gas	Base year emissions	Year t emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year t	% change in emissions between year t and base year	Range of likely % change between year t and base year	
Source		Subcategory		Gg CO_2 equivalent	Gg CO_2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
6B_y	Waste water - N2O pipeline		N2O	91	97	-56	95	0.302	7	-24	51
6B_w	Waste water - N2O not connected		N2O	26	25	-80	209	0.157	-5	-38	50
6C	Waste incineration		N2O	0	0	-72	139	0.000	2	-34	59
2F	Consumption of halocarbons and SF6		HFK	0	708	-40	56	**1.358**	3,861,171	3,861,171	3,861,171
2C3	Aluminium production		PFK	3,370	379	-20	19	**0.291**	-89	-89	-88
2F	Consumption of halocarbons and SF6		PFK	-	0	-39	55	0.000	…	-	-
2C4	SF6 used in Al and Mg foundries		SF6	2,144	-	...	...	-	-100	-100	-100
2F	Consumption of halocarbons and SF6		SF6	56	64	-47	70	0.148	15	15	15

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Annex III: Energy Balance Sheets 1990 - 2011

Annex III

Energy balance	**1990**										
PJ											
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, garbage	Crude oil	Petroleum products	Natural gas and other gases	Waterfall energy	Electricity	District heating
1.1.1 Production of primary energy bearers	4 931.454	8.509	-	-	37.490	3 411.870	49.622	986.988	436.974	-	-
1.1.2 Production of natural gas that is flared off	20.549	-	-	-	-	-	-	20.549	-	-	-
2. Imports	257.784	20.040	15.211	12.844	0.013	68.655	139.819	-	-	1.202	-
3. Exports	4 265.554	7.145	0.129	3.995	0.002	2 897.268	373.462	925.087	-	58.468	-
4.1 Bunkering	19.420	-	-	-	-	-	19.420	-	-	-	-
4.2 Foreign aviation	8.476	-	-	-	-	-	8.476	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-63.929	-0.370	-0.001	-0.621	-	-62.307	-0.630	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	852.408	21.033	15.081	8.228	37.501	520.950	-212.546	82.451	436.974	-57.265	-
8. Energy converted	1 017.153	0.578	1.356	-	2.114	538.980	35.825	0.011	436.974	1.315	-
8.1. In blast furnaces	1.356	-	1.356	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	574.654	-	-	-	-	538.980	35.675	-	-	-	-
8.3. In thermal pow er plants	1.015	-	-	-	0.940	-	0.075	-	-	-	-
8.4. In dual purpose pow er plants	1.081	0.578	-	-	0.504	-	-	-	-	-	-
8.5. In district heating plants	2.073	-	-	-	0.671	-	0.076	0.011	-	1.315	-
8.6. In hydropow er plants	436.974	-	-	-	-	-	-	-	436.974	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	1 034.559	-	-	5.650	-	-	542.148	43.023	-	438.651	5.087
9. Consumption by energy sector	140.740	-	-	-	-	-	3.875	129.832	-	7.032	-
9.1.1 Crude petroleum and natural gas production	-	-	-	-	-	-	-	-	-	-	-
9.1.2 Natural gas w hich is flared off on oil fields	-	-	-	-	-	-	-	-	-	-	-
9.2. Coal mines	-	-	-	-	-	-	-	-	-	-	-
9.3. Petroleum refineries	-	-	-	-	-	-	-	-	-	-	-
9.4. Pumping storage pow er plants	-	-	-	-	-	-	-	-	-	-	-
9.5. Hydro electric pow er plants	-	-	-	-	-	-	-	-	-	-	-
9.6. Thermal pow er plants	-	-	-	-	-	-	-	-	-	-	-
9.7. Combined heat and pow er plants	-	-	-	-	-	-	-	-	-	-	-
9.8. District heating plants	-	-	-	-	-	-	-	-	-	-	-
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	28.912	-	-	-	-	-	-	2.195	-	24.746	1.971
11. Statistical differences (7-8+1.2-9-10-13.1)	-27.972	-0.746	0.771	0.343	-0.073	-18.029	11.671	-21.690	-	-0.219	0.000
13.1 Net domestic consumption including non-energy use	728.134	21.201	12.954	13.535	35.461	-	278.229	15.126	-	348.511	3.117
13. Net domestic consumption	681.330	21.201	12.954	0.356	35.461	-	244.605	15.126	-	348.511	3.117
14. Manufacturing, mining and quarrying	260.311	20.866	12.900	0.356	15.037	-	32.599	15.122	-	162.755	0.675
14.1. Mining and quarrying	4.455	-	-	-	-	-	1.905	-	-	2.550	-
14.2. Manufacture of paper and paper products	36.958	0.181	-	-	10.292	-	2.621	-	-	23.864	-
14.3. Manufacture of industrial chemicals	38.829	-	-	1.277	0.151	-	4.518	13.971	-	18.608	0.304
14.4. Manufacture of iron, steel and ferro alloys	55.284	13.573	-	10.897	0.007	-	1.099	0.435	-	29.249	0.024
14.5. Manufacture of aluminium and other non-ferrous metals	64.780	-	-	0.405	-	-	3.115	0.716	-	60.544	-
14.6. Other manufacturing industries	60.006	7.113	-	0.677	4.587	-	19.341	-	-	27.941	0.346
15. Transport	147.972	-	-	-	-	-	145.626	-	-	2.346	-
15.1. Railw ays and subw ays	3.137	-	-	-	-	-	1.366	-	-	1.770	-
15.2. Air transport	9.299	-	-	-	-	-	9.299	-	-	-	-
15.3. Road transport	108.617	-	-	-	-	-	108.041	-	-	0.576	-
15.4. Coastal shipping	26.919	-	-	-	-	-	26.919	-	-	-	-
16. Other sectors	273.047	0.335	-	0.054	20.423	-	66.380	0.004	-	183.409	2.441
16.1. Fishing	18.715	-	-	-	-	-	18.715	-	-	-	-
16.2. Agriculture	10.532	0.135	-	-	-	-	7.927	-	-	2.449	0.022
16.3. Households	149.480	0.196	-	0.054	20.423	-	18.698	-	-	109.077	1.031
16.4. Other consumers	88.317	0.004	-	-	0.000	-	16.945	0.004	-	69.975	1.389
16.5 Construction	6.004	-	-	-	-	-	4.095	-	-	1.909	-
12. Consumption for non-energy purposes	46.804	-	-	13.179	-	-	33.625	-	-	-	-
12.1 Manufacture of industrial chemicals											
12.2 Other manufacturing											

Annex III

Energy balance	**1991**										
PJ											
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petroleum products	Natural gas and other gases	Waterfall energy	Electricity	District heating
1.1.1 Production of primary energy bearers	5 405.293	9.269	-	-	35.571	3 899.129	49.233	1 014.004	398.088	-	-
1.1.2 Production of natural gas that is flared off	13.454	-	-	-	-	-	-	13.454	-	-	-
2. Imports	251.152	16.891	13.825	12.021	0.014	68.570	128.045	-	-	11.788	-
3. Exports	4 757.167	7.615	0.163	3.063	0.006	3 459.159	332.896	932.487	-	21.777	-
4.1 Bunkering	16.401	-	-	-	-	-	16.401	-	-	-	-
4.2 Foreign aviation	7.657	-	-	-	-	-	7.657	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	14.256	0.587	-0.002	-0.076	-	9.946	3.801	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	902.930	19.131	13.660	8.882	35.578	518.485	-175.876	94.971	398.088	-9.989	-
8. Energy converted	949.382	0.747	1.525	-	2.118	510.223	35.294	0.072	398.088	1.315	-
8.1. In blast furnaces	1.525	-	1.525	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	545.260	-	-	-	-	510.223	35.038	-	-	-	-
8.3. In thermal power plants	1.013	-	-	-	0.944	-	0.069	-	-	-	-
8.4. In dual purpose power plants	1.251	0.747	-	-	0.504	-	-	-	-	-	-
8.5. In district heating plants	2.246	-	-	-	0.671	-	0.187	0.072	-	1.315	-
8.6. In hydropower plants	398.088	-	-	-	-	-	-	-	398.088	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	978.088	-	-	4.988	-	-	527.352	40.554	-	399.633	5.562
9. Consumption by energy sector	138.297	-	-	-	-	-	4.412	126.099	-	7.786	-
9.1.1 Crude petroleum and natural gas production											
9.1.2 Natural gas which is flared off on oil fields											
9.2. Coal mines											
9.3. Petroleum refineries											
9.4. Pumping storage power plants											
9.5. Hydro electric power plants											
9.6. Thermal power plants											
9.7. Combined heat and power plants											
9.8. District heating plants											
9.9. Gas supply											
10. Losses in transport and distribution	28.259	-	-	-	-	-	-	2.222	-	24.131	1.906
11. Statistical differences (7-8+1.2-9-10-13.1)	48.516	0.088	0.032	0.362	-	8.263	47.618	-7.840	-	-0.006	-0.000
13.1 Net domestic consumption including non-energy use	716.565	18.296	12.103	13.507	33.460	-	264.153	14.972	-	356.417	3.657
13. Net domestic consumption	675.870	18.296	12.103	0.194	33.460	-	236.771	14.972	-	356.417	3.657
14. Manufacturing, mining and quarrying	254.684	17.959	12.070	0.194	15.073	-	32.530	14.961	-	161.117	0.779
14.1. Mining and quarrying	4.525	-	-	-	-	-	1.880	-	-	2.645	-
14.2. Manufacture of paper and paper products	37.493	0.424	-	-	10.425	-	3.135	-	-	23.505	0.005
14.3. Manufacture of industrial chemicals	39.556	-	-	1.065	0.137	-	7.017	13.873	-	17.171	0.292
14.4. Manufacture of iron, steel and ferro alloys	49.505	11.296	-	10.454	0.006	-	0.532	0.421	-	26.764	0.032
14.5. Manufacture of aluminium and other non-ferrous metals	65.616	-	-	0.296	-	-	3.131	0.667	-	61.522	-
14.6. Other manufacturing industries	57.989	6.239	-	0.450	4.505	-	16.836	-	-	29.510	0.450
15. Transport	146.715	-	-	-	-	-	144.422	-	-	2.293	-
15.1. Railways and subways	3.114	-	-	-	-	-	1.353	-	-	1.760	-
15.2. Air transport	9.542	-	-	-	-	-	9.542	-	-	-	-
15.3. Road transport	107.440	-	-	-	-	-	106.908	-	-	0.533	-
15.4. Coastal shipping	26.619	-	-	-	-	-	26.619	-	-	-	-
16. Other sectors	274.471	0.337	0.033	-	18.387	-	59.819	0.011	-	193.007	2.878
16.1. Fishing	17.303	-	-	-	-	-	17.244	-	-	-	0.059
16.2. Agriculture	9.958	0.151	-	-	-	-	7.407	-	-	2.383	0.016
16.3. Households	153.477	0.183	-	0.033	18.387	-	16.402	-	-	117.410	1.062
16.4. Other consumers	87.983	0.004	-	-	0.000	-	14.927	0.011	-	71.302	1.740
16.5 Construction	5.750	-	-	-	-	-	3.838	-	-	1.912	-
12. Consumption for non-energy purposes	40.695	-	-	13.313	-	-	27.382	-	-	-	-
12.1 Manufacture of industrial chemicals											
12.2 Other manufacturing											

Annex III

Energy balance	**1992**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	6 038.069	10.084	-	-	37.177	4 472.982	9.312	-	-	-	43.858	1 043.222	-	421.433	-	-
1.1.2 Production of natural gas that is flared off	11.571	-	-	-	-	-	-	-	-	-	-	11.571	-	-	-	-
2. Imports	215.021	17.350	13.379	11.153	0.055	47.396	17.117	6.477	26.307	25.955	44.865	-	-	-	4.967	-
3. Exports	5 324.126	4.724	0.000	3.879	-	3 915.639	125.204	14.872	165.445	58.621	54.435	944.915	-	-	36.392	-
4.1 Bunkering	20.487	-	-	-	-	-	-	-	9.124	11.363	-	-	-	-	-	-
4.2 Foreign aviation	8.249	-	-	-	-	-	-	8.249	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-29.153	-4.359	0.421	0.022	-	-25.154	0.872	-0.554	-0.120	0.018	-0.300	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	882.647	18.352	13.800	7.296	37.232	579.585	-97.903	-17.198	-148.382	-44.011	33.989	109.878	-	421.433	-31.425	-
8. Energy converted	1 045.084	0.752	1.330	-	5.230	571.870	9.550	1.576	2.661	29.006	0.247	-	0.051	421.433	1.379	-
8.1. In blast furnaces	1.330	-	1.330	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	614.785	-	-	-	-	571.870	9.550	1.576	2.552	28.991	0.247	-	-	-	-	-
8.3. In thermal power plants	1.040	-	-	-	0.981	-	-	-	0.057	0.003	-	-	-	-	-	-
8.4. In dual purpose power plants	2.686	0.752	-	-	1.934	-	-	-	-	-	-	-	-	-	-	-
8.5. In district heating plants	3.811	-	-	-	2.316	-	-	-	0.052	0.012	-	-	0.051	-	1.379	-
8.6. In hydropower plants	421.433	-	-	-	-	-	-	-	-	-	-	-	-	421.433	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	1 063.953	-	-	5.795	-	-	185.847	45.147	274.816	67.561	10.251	-	45.934	-	423.021	5.582
9. Consumption by energy sector	147.733	-	-	-	-	-	0.158	0.009	3.651	0.235	-	106.739	29.035	-	7.906	-
9.1.1 Crude petroleum and natural gas production	99.035	-	-	-	-	-	-	-	3.277	0.084	-	95.168	-	-	0.505	-
9.1.2 Natural gas which is flared off on oil fields	11.571	-	-	-	-	-	-	-	-	-	-	11.571	-	-	-	-
9.2. Coal mines	0.242	-	-	-	-	-	0.001	0.001	0.155	-	-	-	-	-	0.084	-
9.3. Petroleum refineries	30.979	-	-	-	-	-	0.002	-	0.095	0.149	-	-	29.035	-	1.698	-
9.4. Pumping storage power plants	2.007	-	-	-	-	-	-	-	-	-	-	-	-	-	2.007	-
9.5. Hydro electric power plants	3.649	-	-	-	-	-	0.155	0.007	0.111	0.001	-	-	-	-	3.375	-
9.6. Thermal power plants	0.091	-	-	-	-	-	-	-	-	-	-	-	-	-	0.091	-
9.7. Combined heat and power plants	0.063	-	-	-	-	-	-	-	0.013	-	-	-	-	-	0.050	-
9.8. District heating plants	0.096	-	-	-	-	-	-	-	-	0.001	-	-	-	-	0.096	-
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	28.877	-	-	-	-	-	-	-	-	-	-	-	2.610	-	24.530	1.737
11. Statistical differences (7-8+1.2-9-10-13.1)	10.109	-0.847	0.369	-0.350	-	7.715	3.809	6.675	-3.187	-17.742	10.527	3.139	-	-	0.002	-0.000
13.1 Net domestic consumption including non-energy use	714.796	18.447	12.101	13.441	32.002	-	74.427	19.691	123.310	12.051	33.466	-	14.237	-	357.778	3.845
13. Net domestic consumption	672.769	18.447	12.101	0.262	32.002	-	74.427	19.691	123.310	12.051	4.618	-	14.237	-	357.778	3.845
14. Manufacturing, mining and quarrying	248.080	18.215	12.059	0.262	13.969	-	-	0.037	13.624	10.728	4.451	-	14.182	-	159.761	0.794
14.1. Mining and quarrying	4.083	-	-	-	-	-	-	0.018	0.882	0.756	0.005	-	-	-	2.421	-
14.2. Manufacture of paper and paper products	34.934	0.242	-	-	9.639	-	-	0.001	0.176	2.358	0.012	-	-	-	22.505	-
14.3. Manufacture of industrial chemicals	35.497	-	1.039	-	-	-	-	-	0.132	1.607	2.157	-	13.162	-	17.080	0.320
14.4. Manufacture of iron, steel and ferro alloys	49.060	11.709	10.349	-	0.001	-	-	0.004	0.199	0.499	0.004	-	0.362	-	25.925	0.009
14.5. Manufacture of aluminium and other non-ferrous metals	62.797	-	0.408	-	-	-	-	-	1.637	0.691	0.287	-	0.657	-	59.116	-
14.6. Other manufacturing industries	61.710	6.263	0.263	0.262	4.329	-	-	0.014	10.598	4.817	1.985	-	-	-	32.713	0.465
15. Transport	150.794	-	-	-	-	-	73.474	9.722	64.104	1.082	-	-	-	-	2.411	-
15.1. Railways and subways	3.844	-	-	-	-	-	-	-	1.433	-	-	-	-	-	2.411	-
15.2. Air transport	9.843	-	-	-	-	-	0.122	9.722	-	-	-	-	-	-	-	-
15.3. Road transport	108.910	-	-	-	-	-	71.629	-	37.281	-	-	-	-	-	-	-
15.4. Coastal shipping	28.195	-	-	-	-	-	1.723	-	25.390	1.082	-	-	-	-	-	-
16. Other sectors	273.895	0.233	0.043	-	18.033	-	0.953	9.932	45.582	0.240	0.167	-	0.056	-	195.606	3.051
16.1. Fishing	16.235	-	-	-	-	-	0.160	0.012	15.917	0.110	-	-	-	-	-	0.036
16.2. Agriculture	9.724	0.097	-	-	-	-	0.065	0.037	7.007	0.053	-	-	-	-	2.442	0.023
16.3. Households	150.661	0.131	0.043	-	18.033	-	0.721	6.030	7.057	0.006	0.115	-	-	-	117.540	0.984
16.4. Other consumers	91.730	0.004	-	-	0.000	-	-	3.823	11.639	0.071	0.052	-	0.056	-	74.076	2.008
16.5 Construction	5.546	-	-	-	-	-	0.006	0.030	3.962	-	-	-	-	-	1.548	-
12. Consumption for non-energy purposes	42.027	-	-	13.179	-	-	-	-	-	-	28.848	-	-	-	-	-
12.1 Manufacture of industrial chemicals	32.909	-	-	4.061	-	-	-	-	-	-	28.848	-	-	-	-	-
12.2 Other manufacturing	9.118	-	-	9.118	-	-	-	-	-	-	-	-	-	-	-	-

Annex III

Energy balance	**1993**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	6 325.123	7.521	-	-	40.877	4 747.167	24.673	-	-	-	62.051	1 012.173	-	430.662	-	-
1.1.2 Production of natural gas that is flared off	13.420	-	-	-	-	-	-	-	-	-	-	13.420	-	-	-	-
2. Imports	228.695	20.127	13.205	12.090	0.038	56.362	18.856	2.616	22.282	35.354	45.653	-	-	-	2.111	-
3. Exports	5 598.629	6.385	0.056	4.795	0.027	4 212.319	132.763	17.296	160.781	59.737	65.779	908.140	-	-	30.550	-
4.1 Bunkering	21.939	-	-	-	-	-	-	-	9.919	12.020	-	-	-	-	-	-
4.2 Foreign aviation	8.690	-	-	-	-	-	-	8.690	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-33.250	1.846	-0.677	0.622	-	-30.597	-5.301	-2.830	3.009	1.049	-0.371	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	904.730	23.109	12.472	7.917	40.887	560.613	-94.535	-26.201	-145.409	-35.354	41.554	117.453	-	430.662	-28.439	-
8. Energy converted	1 051.483	0.713	1.329	-	4.584	569.797	6.793	2.151	5.896	26.850	1.358	-	0.053	430.662	1.299	-
8.1. In blast furnaces	1.329	-	1.329	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	612.746	-	-	-	-	569.797	6.793	2.151	5.806	26.842	1.358	-	-	-	-	-
8.3. In thermal power plants	0.077	-	-	-	-	-	-	-	0.074	0.002	-	-	-	-	-	-
8.4. In dual purpose power plants	2.892	0.713	-	-	2.179	-	-	-	-	-	-	-	-	-	-	-
8.5. In district heating plants	3.777	-	-	-	2.404	-	-	-	0.015	0.006	-	-	0.053	-	1.299	-
8.6. In hydropower plants	430.662	-	-	-	-	-	-	-	-	-	-	-	-	430.662	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	1 078.258	-	-	6.941	-	-	179.951	46.150	281.905	65.517	11.971	-	47.687	-	432.343	5.793
9. Consumption by energy sector	155.516	-	-	-	-	-	0.166	0.011	3.891	0.152	0.482	113.696	29.332	-	7.785	-
9.1.1 Crude petroleum and natural gas production	104.670	-	-	-	-	-	-	-	3.590	0.123	-	100.275	-	-	0.682	-
9.1.2 Natural gas which is flared off on oil fields	13.420	-	-	-	-	-	-	-	-	-	-	13.420	-	-	-	-
9.2. Coal mines	0.173	-	-	-	-	-	0.003	-	0.097	-	-	-	-	-	0.073	-
9.3. Petroleum refineries	31.737	-	-	-	-	-	0.001	-	0.056	0.028	0.482	-	29.332	-	1.838	-
9.4. Pumping storage power plants	2.046	-	-	-	-	-	-	-	-	-	-	-	-	-	2.046	-
9.5. Hydro electric power plants	3.249	-	-	-	-	-	0.163	0.011	0.127	0.001	-	-	-	-	2.946	-
9.6. Thermal power plants	0.062	-	-	-	-	-	-	-	-	-	-	-	-	-	0.062	-
9.7. Combined heat and power plants	0.061	-	-	-	-	-	-	-	-	-	-	-	-	-	0.061	-
9.8. District heating plants	0.098	-	-	-	-	-	-	-	0.021	-	-	-	-	-	0.077	-
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	33.248	-	-	-	-	-	-	-	-	-	-	-	2.772	-	28.713	1.763
11. Statistical differences (7-8+1.2-9-10-13.1)	2.169	1.644	-1.113	0.941	1.043	-9.183	4.174	-0.918	-5.187	-8.817	12.650	3.758	-	-	3.179	-0.000
13.1 Net domestic consumption including non-energy use	740.572	20.752	12.256	13.917	35.260	-	74.283	18.705	131.897	11.978	39.035	-	15.530	-	362.929	4.030
13. Net domestic consumption	690.284	18.522	12.256	0.325	35.260	-	74.273	18.498	131.784	11.371	5.506	-	15.530	-	362.929	4.030
14. Manufacturing, mining and quarrying	255.330	18.332	12.213	0.325	14.647	-	-	0.051	13.726	10.673	5.299	-	15.463	-	163.746	0.854
14.1. Mining and quarrying	4.212	-	-	-	-	-	-	0.019	0.939	0.764	0.010	-	-	-	2.480	-
14.2. Manufacture of paper and paper products	38.532	0.207	-	-	9.778	-	-	0.000	0.142	2.947	0.014	-	-	-	25.443	-
14.3. Manufacture of industrial chemicals	46.917	4.489	1.739	-	-	-	-	-	0.615	1.546	2.647	-	14.387	-	21.026	0.468
14.4. Manufacture of iron, steel and ferro alloys	40.984	8.559	9.896	-	0.003	-	-	0.002	0.200	0.440	0.004	-	0.344	-	21.534	0.002
14.5. Manufacture of aluminium and other non-ferrous metals	64.188	-	0.314	-	-	-	-	-	1.522	0.816	0.355	-	0.732	-	60.449	-
14.6. Other manufacturing industries	60.497	5.078	0.264	0.325	4.866	-	-	0.030	10.308	4.160	2.269	-	-	-	32.815	0.383
15. Transport	159.819	-	-	-	-	-	73.323	9.680	74.085	0.525	-	-	-	-	2.206	-
15.1. Railways and subways	3.665	-	-	-	-	-	-	-	1.459	-	-	-	-	-	2.206	-
15.2. Air transport	9.795	-	-	-	-	-	0.115	9.680	-	-	-	-	-	-	-	-
15.3. Road transport	114.926	-	-	-	-	-	71.485	-	43.441	-	-	-	-	-	-	-
15.4. Coastal shipping	31.433	-	-	-	-	-	1.723	-	29.185	0.525	-	-	-	-	-	-
16. Other sectors	275.135	0.189	0.043	-	20.613	-	0.950	8.767	43.973	0.172	0.207	-	0.066	-	196.978	3.176
16.1. Fishing	16.178	-	-	-	-	-	0.160	0.012	15.726	0.042	-	-	-	-	0.238	-
16.2. Agriculture	12.509	0.063	-	-	-	-	0.058	0.043	6.875	0.058	-	-	-	-	5.411	0.002
16.3. Households	153.271	0.123	0.043	-	20.613	-	0.721	6.119	6.422	0.021	0.138	-	-	-	118.033	1.038
16.4. Other consumers	88.349	0.004	-	-	0.000	-	-	2.575	11.550	0.052	0.069	-	0.066	-	71.896	2.137
16.5 Construction	4.829	-	-	-	-	-	0.010	0.019	3.400	-	-	-	-	-	1.400	-
12. Consumption for non-energy purposes	50.289	2.231	-	13.592	-	-	0.010	0.207	0.113	0.608	33.528	-	-	-	-	-
12.1 Manufacture of industrial chemicals	37.596	-	-	4.067	-	-	-	0.001	-	-	33.528	-	-	-	-	-
12.2 Other manufacturing	12.692	2.231	-	9.525	-	-	0.010	0.206	0.113	0.608	-	-	-	-	-	-

Annex III

Energy balance	**1994**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	7 017.975	8.463	-	-	43.248	5 250.831	88.944	-	-	-	105.422	1 115.400	-	405.666	-	-
1.1.2 Production of natural gas that is flared off	14.295	-	-	-	-	-	-	-	-	-	-	14.295	-	-	-	-
2. Imports	249.431	22.346	15.442	11.805	0.090	44.616	25.719	6.056	21.327	39.376	45.246	-	-	-	17.410	-
3. Exports	6 286.917	5.019	-	4.370	0.002	4 709.499	177.552	17.797	179.693	52.929	102.424	1 019.748	-	-	17.885	-
4.1 Bunkering	24.134	-	-	-	-	-	-	-	10.729	13.406	-	-	-	-	-	-
4.2 Foreign aviation	8.436	-	-	-	-	-	-	8.436	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-19.009	-0.116	0.227	-0.380	-	-10.763	3.328	0.010	-10.398	-1.202	0.285	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	943.204	25.674	15.668	7.055	43.336	575.185	-59.561	-20.167	-179.493	-28.160	48.529	109.948	-	405.666	-0.475	-
8. Energy converted	1 048.313	0.803	1.597	-	5.830	593.148	6.413	2.552	2.045	28.554	0.562	-	0.119	405.666	1.024	-
8.1. In blast furnaces	1.597	-	1.597	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	633.221	-	-	-	-	593.148	6.413	2.552	1.996	28.550	0.562	-	-	-	-	-
8.3. In thermal power plants	1.250	-	-	-	1.200	-	-	-	0.047	0.002	-	-	-	-	-	-
8.4. In dual purpose power plants	2.963	0.803	-	-	2.160	-	-	-	-	-	-	-	-	-	-	-
8.5. In district heating plants	3.617	-	-	-	2.471	-	-	-	0.001	0.001	-	-	0.119	-	1.024	-
8.6. In hydropower plants	405.666	-	-	-	-	-	-	-	-	-	-	-	-	405.666	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	1 077.419	-	-	7.147	-	-	182.079	50.441	294.295	70.228	14.284	-	45.577	-	407.566	5.800
9. Consumption by energy sector	170.047	-	-	-	-	-	0.128	0.004	5.294	0.095	0.798	123.954	28.737	-	11.037	-
9.1.1 Crude petroleum and natural gas production	115.707	-	-	-	-	-	-	-	4.978	0.063	-	109.659	-	-	1.007	-
9.1.2 Natural gas which is flared off on oil fields	14.295	-	-	-	-	-	-	-	-	-	-	14.295	-	-	-	-
9.2. Coal mines	0.217	-	-	-	-	-	0.004	-	0.134	-	-	-	-	-	0.079	-
9.3. Petroleum refineries	31.445	-	-	-	-	-	0.002	-	0.021	0.027	0.798	-	28.737	-	1.860	-
9.4. Pumping storage power plants	5.314	-	-	-	-	-	-	-	-	-	-	-	-	-	5.314	-
9.5. Hydro electric power plants	2.970	-	-	-	-	-	0.122	0.004	0.156	0.005	-	-	-	-	2.682	-
9.6. Thermal power plants	0.029	-	-	-	-	-	-	-	-	-	-	-	-	-	0.029	-
9.7. Combined heat and power plants	0.061	-	-	-	-	-	-	-	0.005	-	-	-	-	-	0.056	-
9.8. District heating plants	0.011	-	-	-	-	-	-	-	-	-	-	-	-	-	0.011	-
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	32.842	-	-	-	-	-	-	-	-	-	-	-	2.905	-	28.357	1.580
11. Statistical differences (7-8+1.2-9-10-13.1)	9.334	0.918	0.800	-1.111	-	-17.963	41.864	5.119	-23.643	-4.137	21.282	-14.122	-0.000	-	0.179	0.149
13.1 Net domestic consumption including non-energy use	760.087	23.953	13.272	15.313	37.506	-	74.113	22.599	131.106	17.556	40.172	0.116	13.816	-	366.494	4.071
13. Net domestic consumption	708.167	21.568	13.272	0.173	37.506	-	74.102	22.395	131.009	17.029	6.617	0.116	13.816	-	366.494	4.071
14. Manufacturing, mining and quarrying	268.393	21.393	13.229	0.173	15.503	-	-	0.053	15.642	16.399	6.392	0.115	13.744	-	164.476	1.274
14.1. Mining and quarrying	4.394	-	-	-	-	-	-	0.019	1.193	0.812	0.012	-	-	-	2.359	-
14.2. Manufacture of paper and paper products	41.620	0.317	-	-	10.525	-	-	0.001	0.294	7.454	0.078	-	-	-	22.950	-
14.3. Manufacture of industrial chemicals	46.687	5.011	1.551	-	-	-	-	-	0.746	2.480	3.060	0.014	12.674	-	20.830	0.320
14.4. Manufacture of iron, steel and ferro alloys	47.031	10.464	11.086	-	-	-	-	0.003	0.212	0.326	0.003	-	0.486	-	24.450	0.003
14.5. Manufacture of aluminium and other non-ferrous metals	65.408	0.001	0.289	-	0.002	-	-	0.006	1.559	0.904	0.355	0.100	0.584	-	61.607	-
14.6. Other manufacturing industries	63.253	5.600	0.304	0.173	4.975	-	-	0.024	11.638	4.424	2.885	-	-	-	32.280	0.951
15. Transport	156.218	-	-	-	-	-	73.161	10.838	69.682	0.358	-	-	-	-	2.178	-
15.1. Railways and subways	3.733	-	-	-	-	-	-	-	1.555	-	-	-	-	-	2.178	-
15.2. Air transport	10.949	-	-	-	-	-	0.112	10.838	-	-	-	-	-	-	-	-
15.3. Road transport	111.894	-	-	-	-	-	71.326	-	40.568	-	-	-	-	-	-	-
15.4. Coastal shipping	29.640	-	-	-	-	-	1.723	-	27.559	0.358	-	-	-	-	-	-
16. Other sectors	283.557	0.175	0.043	-	22.003	-	0.941	11.504	45.684	0.272	0.225	0.001	0.072	-	199.840	2.798
16.1. Fishing	16.987	-	-	-	-	-	0.160	0.009	16.516	0.040	-	-	-	-	0.263	-
16.2. Agriculture	12.516	0.049	-	-	-	-	0.047	0.047	6.766	0.064	-	-	-	-	5.537	0.006
16.3. Households	158.721	0.122	0.043	-	22.003	-	0.721	6.629	5.670	0.005	0.138	-	-	-	122.454	0.935
16.4. Other consumers	89.667	0.004	-	-	0.000	-	-	4.788	12.676	0.163	0.086	0.001	0.072	-	70.020	1.857
16.5 Construction	5.666	-	-	-	-	-	0.013	0.032	4.055	-	-	-	-	-	1.566	-
12. Consumption for non-energy purposes	51.920	2.385	-	15.141	-	-	0.011	0.204	0.098	0.527	33.555	-	-	-	-	-
12.1 Manufacture of industrial chemicals	38.098	-	-	4.542	-	-	-	0.001	-	-	33.555	-	-	-	-	-
12.2 Other manufacturing	13.821	2.385	-	10.598	-	-	0.011	0.203	0.098	0.527	-	-	-	-	-	-

Annex III

Energy balance	**1995**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	7 524.598	8.208	-	-	43.916	5 635.739	113.554	-	-	-	125.714	1 156.477	-	440.991	-	-
1.1.2 Production of natural gas that is flared off	15.851	-	-	-	-	-	-	-	-	-	-	15.851	-	-	-	-
2. Imports	260.117	26.133	14.865	14.229	0.088	59.496	34.682	4.011	28.203	27.471	42.658	-	-	-	8.281	-
3. Exports	6 767.676	5.066	-	4.473	0.000	5 154.679	183.678	14.159	154.107	53.049	127.919	1 038.281	-	-	32.264	-
4.1 Bunkering	29.546	-	-	-	-	-	-	-	13.876	15.670	-	-	-	-	-	-
4.2 Foreign aviation	8.012	-	-	-	-	-	-	8.012	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-2.974	-0.673	-0.620	0.676	-	-9.650	-1.859	8.325	7.023	1.502	-7.696	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	992.359	28.602	14.245	10.432	44.004	530.906	-37.302	-9.835	-132.757	-39.746	32.757	134.046	-	440.991	-23.984	-
8. Energy converted	1 034.594	0.835	1.540	0.161	6.220	541.856	8.660	3.005	9.104	20.182	0.544	-	0.112	440.991	1.382	-
8.1. In blast furnaces	1.540	-	1.540	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	583.191	-	-	0.161	-	541.856	8.660	3.005	8.787	20.178	0.544	-	-	-	-	-
8.3. In thermal power plants	1.349	-	-	-	1.304	-	-	-	0.040	0.005	-	-	-	-	-	-
8.4. In dual purpose power plants	3.171	0.835	-	-	2.336	-	-	-	-	-	-	-	-	-	-	-
8.5. In district heating plants	4.351	-	-	-	2.579	-	-	-	0.278	-	-	-	0.112	-	1.382	-
8.6. In hydropower plants	440.991	-	-	-	-	-	-	-	-	-	-	-	-	440.991	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	1 051.757	-	-	5.801	-	-	160.791	45.645	266.667	71.907	13.582	-	38.571	-	442.841	5.952
9. Consumption by energy sector	167.429	-	-	-	-	-	0.139	0.001	5.351	0.091	-	126.700	25.114	-	10.033	-
9.1.1 Crude petroleum and natural gas production	117.031	-	-	-	-	-	-	-	5.061	0.061	-	110.849	-	-	1.061	-
9.1.2 Natural gas which is flared off on oil fields	15.851	-	-	-	-	-	-	-	-	-	-	15.851	-	-	-	-
9.2. Coal mines	0.227	-	-	-	-	-	0.003	-	0.131	-	-	-	-	-	0.092	-
9.3. Petroleum refineries	26.937	-	-	-	-	-	0.002	-	0.034	0.027	-	-	25.114	-	1.761	-
9.4. Pumping storage power plants	4.920	-	-	-	-	-	-	-	-	-	-	-	-	-	4.920	-
9.5. Hydro electric power plants	2.352	-	-	-	-	-	0.134	0.001	0.106	0.004	-	-	-	-	2.107	-
9.6. Thermal power plants	0.024	-	-	-	-	-	-	-	-	-	-	-	-	-	0.024	-
9.7. Combined heat and power plants	0.027	-	-	-	-	-	-	-	0.007	-	-	-	-	-	0.020	-
9.8. District heating plants	0.060	-	-	-	-	-	-	-	0.012	-	-	-	-	-	0.048	-
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	30.234	-	-	-	-	-	-	-	-	-	-	-	2.544	-	26.145	1.545
11. Statistical differences (7-8+1.2-9-10-13.1)	40.417	1.196	-1.355	0.215	-	-10.950	41.557	10.056	-15.833	-2.598	3.826	6.559	0.003	-	7.739	0.002
13.1 Net domestic consumption including non-energy use	771.442	26.571	14.061	15.857	37.784	-	73.133	22.747	135.286	14.485	41.970	0.787	10.798	-	373.558	4.406
13. Net domestic consumption	718.449	23.481	14.061	0.310	37.784	-	73.122	22.506	135.176	13.915	8.546	0.787	10.798	-	373.558	4.406
14. Manufacturing, mining and quarrying	272.789	23.342	14.018	0.310	16.224	-	-	0.055	14.863	13.300	7.764	0.784	10.674	-	170.006	1.450
14.1. Mining and quarrying	3.677	-	-	-	-	-	-	0.020	1.307	0.528	0.008	-	-	-	1.814	-
14.2. Manufacture of paper and paper products	42.848	0.290	-	-	11.126	-	-	0.000	0.333	6.144	0.146	-	-	-	24.809	-
14.3. Manufacture of industrial chemicals	45.091	5.177	1.660	-	-	-	-	-	0.822	1.697	3.869	0.168	9.521	-	21.889	0.288
14.4. Manufacture of iron, steel and ferro alloys	50.900	12.254	11.612	-	-	-	-	0.002	0.107	0.183	0.004	-	0.634	-	26.100	0.003
14.5. Manufacture of aluminium and other non-ferrous metals	65.964	-	0.361	-	-	-	-	0.006	1.444	0.866	0.320	0.543	0.519	-	61.903	-
14.6. Other manufacturing industries	64.310	5.621	0.384	0.310	5.098	-	-	0.026	10.849	3.882	3.417	0.074	-	-	33.490	1.158
15. Transport	161.060	-	-	-	-	-	72.174	11.669	74.398	0.510	-	-	-	-	2.309	-
15.1. Railways and subways	3.795	-	-	-	-	-	-	-	1.486	-	-	-	-	-	2.309	-
15.2. Air transport	11.767	-	-	-	-	-	0.098	11.669	-	-	-	-	-	-	-	-
15.3. Road transport	114.929	-	-	-	-	-	70.353	-	44.576	-	-	-	-	-	-	-
15.4. Coastal shipping	30.569	-	-	-	-	-	1.723	-	28.336	0.510	-	-	-	-	-	-
16. Other sectors	284.600	0.139	0.043	-	21.560	-	0.947	10.782	45.915	0.105	0.782	0.003	0.124	-	201.244	2.956
16.1. Fishing	17.281	-	-	-	-	-	0.162	0.009	16.759	0.035	-	-	-	-	0.317	-
16.2. Agriculture	11.697	0.020	-	-	-	-	0.054	0.054	6.660	0.044	-	-	-	-	4.849	0.017
16.3. Households	160.689	0.115	0.043	-	21.445	-	0.721	6.387	6.132	0.005	0.138	-	-	-	124.657	1.045
16.4. Other consumers	88.517	0.004	-	-	0.000	-	-	4.287	12.269	0.021	0.104	0.003	0.124	-	69.811	1.894
16.5 Construction	6.416	-	-	-	0.115	-	0.010	0.046	4.096	-	0.540	-	-	-	1.609	-
12. Consumption for non-energy purposes	52.993	3.090	-	15.547	-	-	0.011	0.241	0.110	0.570	33.424	-	-	-	-	-
12.1 Manufacture of industrial chemicals	37.962	-	-	4.537	-	-	-	0.001	-	-	33.424	-	-	-	-	-
12.2 Other manufacturing	15.031	3.090	-	11.009	-	-	0.011	0.240	0.110	0.570	-	-	-	-	-	-

Annex III

Energy balance	**1996**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	8 533.997	6.453	-	-	45.196	6 322.884	133.692	-	-	-	137.419	1 513.387	-	374.965	-	-
1.1.2 Production of natural gas that is flared off	18.156	-	-	-	-	-	-	-	-	-	-	18.156	-	-	-	-
2. Imports	290.860	23.381	17.014	12.958	0.094	56.375	21.405	5.490	25.932	40.177	40.470	-	-	-	47.563	-
3. Exports	7 814.237	4.388	0.273	4.506	0.004	5 786.633	221.788	19.244	151.780	59.930	137.663	1 412.778	-	-	15.251	-
4.1 Bunkering	32.463	-	-	-	-	-	-	-	14.900	17.563	-	-	-	-	-	-
4.2 Foreign aviation	9.461	-	-	-	-	-	-	9.461	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-35.912	0.801	-0.919	-0.857	-	-27.194	-1.746	-7.589	-7.425	-0.602	9.620	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	950.941	26.247	15.822	7.596	45.286	565.433	-68.436	-30.804	-148.173	-37.918	49.847	118.764	-	374.965	32.312	-
8. Energy converted	1 033.646	0.785	1.499	-	6.057	601.254	5.067	3.791	11.954	26.505	1.182	-	0.053	374.965	0.533	-
8.1. In blast furnaces	1.499	-	1.499	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	648.011	-	-	-	-	601.254	5.067	3.791	10.211	26.505	1.182	-	-	-	-	-
8.3. In thermal power plants	1.271	-	-	-	1.205	-	-	-	0.065	-	-	-	-	-	-	-
8.4. In dual purpose power plants	2.938	0.785	-	-	2.154	-	-	-	-	-	-	-	-	-	-	-
8.5. In district heating plants	4.962	-	-	-	2.698	-	-	-	1.678	-	-	-	0.053	-	0.533	-
8.6. In hydropower plants	374.965	-	-	-	-	-	-	-	-	-	-	-	-	374.965	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	1 060.753	-	-	7.331	-	-	176.808	58.984	298.405	76.867	15.269	-	43.849	-	376.963	6.276
9. Consumption by energy sector	178.802	-	-	-	-	-	0.102	0.006	5.923	0.041	-	135.970	29.037	-	7.722	-
9.1.1 Crude petroleum and natural gas production	125.671	-	-	-	-	-	-	-	5.692	-	-	117.814	-	-	2.164	-
9.1.2 Natural gas which is flared off on oil fields	18.156	-	-	-	-	-	-	-	-	-	-	18.156	-	-	-	-
9.2. Coal mines	0.169	-	-	-	-	-	0.009	-	0.088	-	-	-	-	-	0.072	-
9.3. Petroleum refineries	30.886	-	-	-	-	-	0.002	-	0.006	0.037	-	-	29.037	-	1.804	-
9.4. Pumping storage power plants	1.470	-	-	-	-	-	-	-	-	-	-	-	-	-	1.470	-
9.5. Hydro electric power plants	2.364	-	-	-	-	-	0.092	0.006	0.126	0.004	-	-	-	-	2.136	-
9.6. Thermal power plants	0.015	-	-	-	-	-	-	-	-	-	-	-	-	-	0.015	-
9.7. Combined heat and power plants	0.026	-	-	-	-	-	-	-	0.004	-	-	-	-	-	0.022	-
9.8. District heating plants	0.045	-	-	-	-	-	-	-	0.007	-	-	-	-	-	0.039	-
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	30.920	-	-	-	-	-	-	-	-	-	-	-	2.977	-	26.484	1.460
11. Statistical differences (7-8+1.2-9-10-13.1)	-27.865	-0.633	0.007	-0.671	-	-35.821	28.951	0.020	-20.211	-6.262	21.820	-18.288	0.005	-	3.218	-0.000
13.1 Net domestic consumption including non-energy use	796.190	26.095	14.316	15.599	39.229	-	74.252	24.362	152.567	18.664	42.114	1.081	11.778	-	371.317	4.817
13. Net domestic consumption	743.278	23.475	14.316	0.244	39.229	-	74.241	24.126	152.449	18.040	8.166	1.081	11.778	-	371.317	4.817
14. Manufacturing, mining and quarrying	268.793	23.378	14.273	0.244	16.270	-	-	0.104	17.556	17.377	7.343	1.076	11.634	-	158.371	1.167
14.1. Mining and quarrying	3.603	-	-	-	-	-	-	0.019	0.959	0.590	0.005	-	-	-	2.030	-
14.2. Manufacture of paper and paper products	44.647	0.338	-	-	10.513	-	-	-	0.833	8.714	0.274	-	-	-	23.975	-
14.3. Manufacture of industrial chemicals	46.603	5.194	1.625	-	0.006	-	-	0.000	1.018	2.092	3.992	0.161	10.556	-	21.675	0.284
14.4. Manufacture of iron, steel and ferro alloys	49.686	12.306	11.916	-	-	-	-	0.000	0.254	0.339	0.005	-	0.398	-	24.465	0.003
14.5. Manufacture of aluminium and other non-ferrous metals	61.117	-	0.313	0.012	-	-	-	0.007	1.317	0.948	0.532	0.681	0.604	-	56.703	-
14.6. Other manufacturing industries	63.138	5.540	0.418	0.232	5.752	-	-	0.077	13.177	4.695	2.535	0.235	0.077	-	29.523	0.880
15. Transport	168.992	-	-	-	-	-	73.302	12.970	80.052	0.442	-	0.001	-	-	2.225	-
15.1. Railways and subways	3.303	-	-	-	-	-	-	-	1.078	-	-	-	-	-	2.225	-
15.2. Air transport	13.075	-	-	-	-	-	0.105	12.970	-	-	-	-	-	-	-	-
15.3. Road transport	121.110	-	-	-	-	-	71.474	-	49.635	-	-	0.001	-	-	-	-
15.4. Coastal shipping	31.504	-	-	-	-	-	1.723	-	29.339	0.442	-	-	-	-	-	-
16. Other sectors	305.493	0.097	0.043	-	22.959	-	0.939	11.052	54.842	0.220	0.824	0.004	0.143	-	210.722	3.650
16.1. Fishing	19.252	-	-	-	-	-	0.162	0.007	18.660	0.102	-	-	-	-	0.320	-
16.2. Agriculture	11.627	0.013	-	-	-	-	0.045	0.058	7.200	0.107	-	-	-	-	4.172	0.032
16.3. Households	167.863	0.080	0.043	-	22.841	-	0.721	7.543	8.287	-	0.159	-	-	-	127.037	1.153
16.4. Other consumers	99.299	0.004	-	-	-	-	-	3.392	16.510	0.011	0.109	0.004	0.143	-	76.661	2.465
16.5 Construction	7.452	-	-	-	0.118	-	0.011	0.051	4.185	-	0.556	-	-	-	2.531	-
12. Consumption for non-energy purposes	52.911	2.620	-	15.355	-	-	0.011	0.235	0.117	0.625	33.947	-	-	-	-	-
12.1 Manufacture of industrial chemicals	38.764	-	-	4.816	-	-	-	0.001	-	-	33.947	-	-	-	-	-
12.2 Other manufacturing	14.147	2.620	-	10.540	-	-	0.011	0.234	0.117	0.625	-	-	-	-	-	-

Annex III

Energy balance	**1997**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	8 811.324	10.859	-	-	47.554	6 329.405	186.785	-	-	-	138.226	1 699.119	-	399.376	-	-
1.1.2 Production of natural gas that is flared off	16.255	-	-	-	-	-	-	-	-	-	-	16.255	-	-	-	-
2. Imports	299.087	24.190	14.327	12.840	0.117	65.973	28.164	5.581	23.089	51.878	41.636	-	-	-	31.293	-
3. Exports	8 059.246	5.158	0.116	3.224	0.000	5 818.286	279.530	13.157	158.644	66.447	144.411	1 552.727	-	-	17.547	-
4.1 Bunkering	39.421	-	-	-	-	-	-	-	19.945	19.476	-	-	-	-	-	-
4.2 Foreign aviation	10.548	-	-	-	-	-	-	10.548	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	0.912	-1.885	0.898	-0.339	-	13.993	0.515	-3.482	-5.308	-0.222	-3.258	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 018.364	28.006	15.109	9.277	47.671	591.085	-64.066	-21.606	-160.807	-34.267	32.192	162.648	-	399.376	13.745	-
8. Energy converted	1 064.890	0.687	1.748	-	6.052	596.941	1.367	3.425	10.833	43.072	0.777	-	0.011	399.376	0.599	-
8.1. In blast furnaces	1.748	-	1.748	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	655.293	-	-	-	-	596.941	1.367	3.425	9.714	43.068	0.777	-	-	-	-	-
8.3. In thermal power plants	1.021	-	-	-	1.014	-	-	-	0.002	0.004	-	-	-	-	-	-
8.4. In dual purpose power plants	2.828	0.687	-	-	2.138	-	-	-	0.003	-	-	-	-	-	-	-
8.5. In district heating plants	4.624	-	-	-	2.900	-	-	-	1.114	-	-	-	0.011	-	0.599	-
8.6. In hydropower plants	399.376	-	-	-	-	-	-	-	-	-	-	-	-	399.376	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	1 086.578	-	-	6.894	-	-	177.246	45.745	309.453	76.771	16.509	-	46.416	-	401.111	6.432
9. Consumption by energy sector	188.369	-	-	-	-	-	0.092	0.002	6.654	0.038	-	138.029	30.173	-	13.381	-
9.1.1 Crude petroleum and natural gas production	131.511	-	-	-	-	-	-	-	6.402	-	-	121.773	-	-	3.336	-
9.1.2 Natural gas which is flared off on oil fields	16.255	-	-	-	-	-	-	-	-	-	-	16.255	-	-	-	-
9.2. Coal mines	0.172	-	-	-	-	-	0.002	-	0.126	-	-	-	-	-	0.044	-
9.3. Petroleum refineries	31.996	-	-	-	-	-	0.001	-	0.001	0.036	-	-	30.173	-	1.785	-
9.4. Pumping storage power plants	5.979	-	-	-	-	-	-	-	-	-	-	-	-	-	5.979	-
9.5. Hydro electric power plants	2.353	-	-	-	-	-	0.090	0.002	0.102	0.001	-	-	-	-	2.158	-
9.6. Thermal power plants	0.019	-	-	-	-	-	-	-	-	-	-	-	-	-	0.019	-
9.7. Combined heat and power plants	0.035	-	-	-	-	-	-	-	0.014	-	-	-	-	-	0.021	-
9.8. District heating plants	0.048	-	-	-	-	-	-	-	0.009	-	-	-	-	-	0.039	-
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	31.807	-	-	-	-	-	-	-	-	-	-	0.264	3.041	-	26.829	1.674
11. Statistical differences (7-8+1.2-9-10-13.1)	10.870	1.468	-0.898	0.248	-	-5.856	38.660	-3.381	-17.463	-17.686	4.468	11.279	0.011	-	0.019	0.000
13.1 Net domestic consumption including non-energy use	809.006	25.851	14.258	15.923	41.619	-	73.061	24.093	148.621	17.080	43.457	13.076	13.180	-	374.028	4.759
13. Net domestic consumption	745.128	22.919	14.258	0.242	41.619	-	73.046	23.804	148.493	16.432	7.447	4.901	13.180	-	374.028	4.759
14. Manufacturing, mining and quarrying	273.452	22.801	14.221	0.242	17.705	-	-	0.074	14.757	15.552	6.520	4.890	13.078	-	162.690	0.920
14.1. Mining and quarrying	2.921	-	-	-	-	-	-	0.027	0.898	0.240	0.004	-	-	-	1.753	-
14.2. Manufacture of paper and paper products	42.149	0.259	-	-	11.392	-	-	-	0.258	6.766	0.112	-	-	-	23.362	0.001
14.3. Manufacture of industrial chemicals	51.203	5.006	1.652	-	0.006	-	-	0.004	0.579	3.294	2.962	3.872	11.662	-	21.853	0.315
14.4. Manufacture of iron, steel and ferro alloys	48.473	11.471	11.838	-	-	-	-	-	0.205	0.178	0.010	-	0.639	-	24.126	0.006
14.5. Manufacture of aluminium and other non-ferrous metals	65.802	-	0.343	0.012	-	-	-	0.007	1.111	0.582	0.965	0.636	0.640	-	61.483	0.023
14.6. Other manufacturing industries	62.904	6.064	0.388	0.230	6.308	-	-	0.037	11.707	4.493	2.468	0.382	0.138	-	30.113	0.576
15. Transport	171.913	-	-	-	-	-	72.096	13.334	83.516	0.762	-	0.006	-	-	2.199	-
15.1. Railways and subways	3.313	-	-	-	-	-	-	-	1.114	-	-	-	-	-	2.199	-
15.2. Air transport	13.438	-	-	-	-	-	0.104	13.334	-	-	-	-	-	-	-	-
15.3. Road transport	120.608	-	-	-	-	-	70.269	-	50.333	-	-	0.006	-	-	-	-
15.4. Coastal shipping	34.554	-	-	-	-	-	1.723	-	32.068	0.762	-	-	-	-	-	-
16. Other sectors	299.763	0.119	0.037	-	23.914	-	0.950	10.396	50.220	0.117	0.927	0.006	0.101	-	209.139	3.838
16.1. Fishing	20.285	-	-	-	-	-	0.177	0.008	19.672	0.018	-	-	-	-	0.410	-
16.2. Agriculture	10.455	0.017	-	-	-	-	0.040	0.046	6.285	0.091	-	-	-	-	3.913	0.063
16.3. Households	161.311	0.098	0.037	-	23.785	-	0.721	6.855	6.297	-	0.205	-	-	-	122.321	0.992
16.4. Other consumers	100.092	0.004	-	-	-	-	-	3.449	13.386	0.008	0.115	0.005	0.101	-	80.241	2.783
16.5 Construction	7.619	-	-	-	0.129	-	0.012	0.038	4.579	-	0.607	0.000	-	-	2.254	-
12. Consumption for non-energy purposes	63.878	2.931	-	15.681	-	-	0.015	0.289	0.128	0.648	36.010	8.175	-	-	-	-
12.1 Manufacture of industrial chemicals	48.777	-	-	4.590	-	-	-	0.002	-	-	36.010	8.175	-	-	-	-
12.2 Other manufacturing	15.101	2.931	-	11.091	-	-	0.015	0.287	0.128	0.648	-	-	-	-	-	-

Annex III

Energy balance	**1998**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	8 561.894	9.222	-	-	44.444	6 052.693	175.077	-	-	-	135.589	1 726.222	-	418.648	-	-
1.1.2 Production of natural gas that is flared off	16.853	-	-	-	-	-	-	-	-	-	-	16.853	-	-	-	-
2. Imports	282.236	27.180	16.429	13.042	0.249	81.292	21.472	10.569	21.172	40.097	21.768	-	-	-	28.966	-
3. Exports	7 742.437	8.188	0.297	3.012	0.002	5 552.662	269.089	9.653	162.036	57.968	108.495	1 555.153	-	-	15.883	-
4.1 Bunkering	37.750	-	-	-	-	-	-	-	20.751	16.999	-	-	-	-	-	-
4.2 Foreign aviation	11.239	-	-	-	-	-	-	11.239	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	25.811	0.525	-0.037	-0.396	-	23.203	0.882	1.272	-0.056	1.993	-1.575	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 095.370	28.738	16.096	9.635	44.691	604.525	-71.658	-9.051	-161.671	-32.877	47.288	187.922	-	418.648	13.082	-
8. Energy converted	1 070.823	0.686	2.123	-	6.398	598.235	2.282	1.679	5.633	33.349	1.099	0.040	0.030	418.648	0.620	-
8.1. In blast furnaces	2.123	-	2.123	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	640.839	-	-	-	-	598.235	2.282	1.679	4.202	33.340	1.099	-	-	-	-	-
8.3. In thermal power plants	1.131	-	-	-	1.125	-	-	-	0.001	0.005	-	-	-	-	-	-
8.4. In dual purpose power plants	2.969	0.686	-	-	2.283	-	-	-	-	-	-	-	-	-	-	-
8.5. In district heating plants	5.113	-	-	-	2.991	-	-	-	1.429	0.003	-	0.040	0.030	-	0.620	-
8.6. In hydropower plants	418.648	-	-	-	-	-	-	-	-	-	-	-	-	418.648	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	1 078.581	-	-	6.585	-	-	173.591	35.931	302.957	71.284	15.116	-	45.272	-	421.206	6.639
9. Consumption by energy sector	179.379	-	-	-	-	-	0.077	0.001	6.511	0.083	0.876	132.260	28.622	-	10.949	-
9.1.1 Crude petroleum and natural gas production	125.160	-	-	-	-	-	-	-	6.225	-	-	115.407	-	-	3.527	-
9.1.2 Natural gas which is flared off on oil fields	16.853	-	-	-	-	-	-	-	-	-	-	16.853	-	-	-	-
9.2. Coal mines	0.201	-	-	-	-	-	0.002	-	0.155	-	-	-	-	-	0.044	-
9.3. Petroleum refineries	31.434	-	-	-	-	-	0.001	-	0.037	0.036	0.876	-	28.622	-	1.862	-
9.4. Pumping storage power plants	2.966	-	-	-	-	-	-	-	-	-	-	-	-	-	2.966	-
9.5. Hydro electric power plants	2.628	-	-	-	-	-	0.075	0.001	0.066	0.045	-	-	-	-	2.441	-
9.6. Thermal power plants	0.037	-	-	-	-	-	-	-	-	-	-	-	-	-	0.037	-
9.7. Combined heat and power plants	0.026	-	-	-	-	-	-	-	0.010	-	-	-	-	-	0.015	-
9.8. District heating plants	0.075	-	-	-	-	-	-	-	0.016	0.002	-	-	-	-	0.056	-
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	33.779	-	-	-	-	-	-	-	-	-	-	0.811	3.476	-	27.945	1.547
11. Statistical differences (7-8+1.2-9-10-13.1)	51.205	-0.520	-0.955	2.068	-	6.290	25.697	2.188	-24.686	-12.491	19.861	33.753	-0.000	-	0.000	-
13.1 Net domestic consumption including non-energy use	838.764	28.572	14.928	14.151	38.292	-	73.876	23.012	153.829	17.466	40.568	21.058	13.145	-	394.773	5.092
13. Net domestic consumption	771.170	24.534	14.928	0.271	38.292	-	73.862	22.728	153.702	16.818	7.226	5.799	13.145	-	394.773	5.092
14. Manufacturing, mining and quarrying	288.474	24.421	14.891	0.271	15.455	-	-	0.043	16.265	15.867	6.173	5.766	12.998	-	175.475	0.848
14.1. Mining and quarrying	3.304	-	-	-	-	-	-	0.007	1.263	0.195	0.001	-	-	-	1.838	-
14.2. Manufacture of paper and paper products	40.848	0.154	-	-	10.901	-	-	0.000	0.272	6.538	0.205	-	-	-	22.777	0.000
14.3. Manufacture of industrial chemicals	54.124	5.792	1.454	-	0.115	-	-	-	0.449	3.350	2.402	4.703	11.426	-	24.139	0.292
14.4. Manufacture of iron, steel and ferro alloys	54.354	12.824	12.551	-	-	-	-	0.001	0.291	0.095	0.015	-	0.749	-	27.823	0.006
14.5. Manufacture of aluminium and other non-ferrous metals	72.023	0.000	0.441	-	-	-	-	0.007	1.254	0.536	0.840	0.553	0.666	-	67.705	0.020
14.6. Other manufacturing industries	63.821	5.652	0.445	0.271	4.438	-	-	0.028	12.737	5.153	2.710	0.510	0.157	-	31.192	0.529
15. Transport	175.329	-	-	-	-	-	72.922	13.662	85.708	0.731	-	0.009	-	-	2.298	-
15.1. Railways and subways	3.186	-	-	-	-	-	-	-	0.888	-	-	-	-	-	2.298	-
15.2. Air transport	13.758	-	-	-	-	-	0.095	13.662	-	-	-	-	-	-	-	-
15.3. Road transport	120.791	-	-	-	-	-	71.104	-	49.679	-	-	0.009	-	-	-	-
15.4. Coastal shipping	37.594	-	-	-	-	-	1.723	-	35.141	0.731	-	-	-	-	-	-
16. Other sectors	307.368	0.113	0.037	-	22.837	-	0.940	9.022	51.730	0.220	1.053	0.024	0.147	-	217.001	4.244
16.1. Fishing	20.951	-	-	-	-	-	0.173	0.007	20.282	-	-	-	-	-	0.490	-
16.2. Agriculture	13.700	-	-	-	0.070	-	0.034	0.042	6.702	0.164	0.107	-	-	-	6.541	0.040
16.3. Households	164.436	0.109	0.037	-	22.629	-	0.721	6.270	7.212	0.040	0.174	-	-	-	126.173	1.070
16.4. Other consumers	100.508	0.004	-	-	-	-	-	2.655	12.658	0.017	0.121	0.023	0.147	-	81.749	3.134
16.5 Construction	7.773	-	-	-	0.138	-	0.013	0.046	4.876	-	0.650	0.002	-	-	2.048	-
12. Consumption for non-energy purposes	67.594	4.038	-	13.881	-	-	0.014	0.284	0.127	0.648	33.342	15.259	-	-	-	-
12.1 Manufacture of industrial chemicals	53.593	-	-	4.990	-	-	-	0.002	-	-	33.342	15.259	-	-	-	-
12.2 Other manufacturing	14.001	4.038	-	8.890	-	-	0.014	0.283	0.127	0.648	-	-	-	-	-	-

Annex III

Energy balance	1999															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	8 697.003	11.351	-	-	46.670	6 000.616	181.311	-	-	-	161.764	1 856.425	-	438.867	-	-
1.1.2 Production of natural gas that is flared off	24.733	-	-	-	-	-	-	-	-	-	-	24.733	-	-	-	-
2. Imports	283.765	25.696	14.941	13.698	0.435	88.830	17.818	12.152	16.764	47.211	21.535	-	-	-	24.684	-
3. Exports	7 794.890	8.085	0.180	1.529	0.002	5 435.818	288.520	8.612	150.199	66.513	108.846	1 694.993	-	-	31.593	-
4.1 Bunkering	35.323	-	-	-	-	-	-	-	20.109	15.214	-	-	-	-	-	-
4.2 Foreign aviation	12.884	-	-	-	-	-	-	12.884	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-0.293	0.525	0.213	0.260	-	0.629	-7.629	-1.423	6.573	-1.059	1.617	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 162.111	29.488	14.974	12.428	47.104	654.257	-97.020	-10.768	-146.970	-35.576	76.070	186.165	-	438.867	-6.910	-
8. Energy converted	1 108.395	0.697	1.703	-	6.665	606.546	4.626	2.858	2.980	41.816	1.091	0.100	0.039	438.867	0.406	-
8.1. In blast furnaces	1.703	-	1.703	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	658.055	-	-	-	-	606.546	4.626	2.858	1.126	41.808	1.091	-	-	-	-	-
8.3. In thermal power plants	1.353	-	-	-	1.267	-	-	-	0.081	0.004	-	-	-	-	-	-
8.4. In dual purpose power plants	3.083	0.697	-	-	2.370	-	-	-	0.016	-	-	-	-	-	-	-
8.5. In district heating plants	5.334	-	-	-	3.028	-	-	-	1.757	0.004	-	0.100	0.039	-	0.406	-
8.6. In hydropower plants	438.867	-	-	-	-	-	-	-	-	-	-	-	-	438.867	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	1 131.206	-	-	7.252	-	-	183.627	34.359	321.035	74.416	14.821	-	46.367	-	442.201	7.127
9. Consumption by energy sector	181.232	-	-	-	-	-	0.061	0.001	6.911	0.074	0.995	130.867	30.130	-	12.176	0.019
9.1.1 Crude petroleum and natural gas production	117.287	-	-	-	-	-	-	-	6.718	-	-	106.134	-	-	4.436	-
9.1.2 Natural gas which is flared off on oil fields	24.733	-	-	-	-	-	-	-	-	-	-	24.733	-	-	-	-
9.2. Coal mines	0.096	-	-	-	-	-	-	-	0.040	-	-	-	-	-	0.037	0.019
9.3. Petroleum refineries	33.056	-	-	-	-	-	0.001	-	0.049	0.057	0.995	-	30.130	-	1.825	-
9.4. Pumping storage power plants	2.213	-	-	-	-	-	-	-	-	-	-	-	-	-	2.213	-
9.5. Hydro electric power plants	3.686	-	-	-	-	-	0.060	0.001	0.064	0.016	-	-	-	-	3.544	-
9.6. Thermal power plants	0.024	-	-	-	-	-	-	-	-	-	-	-	-	-	0.024	-
9.7. Combined heat and power plants	0.032	-	-	-	-	-	-	-	0.014	-	-	-	-	-	0.019	-
9.8. District heating plants	0.104	-	-	-	-	-	-	-	0.026	-	-	-	-	-	0.079	-
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	33.024	-	-	-	-	-	-	-	-	-	-	0.678	3.949	-	26.845	1.552
11. Statistical differences (7-8+1.2-9-10-13.1)	125.559	1.279	0.011	5.253	-	47.712	8.530	-4.830	3.481	-18.451	51.985	30.589	-	-	0.000	-0.000
13.1 Net domestic consumption including non-energy use	845.106	27.511	13.260	14.427	40.439	-	73.390	25.562	160.693	15.402	36.821	23.930	12.249	-	395.865	5.557
13. Net domestic consumption	779.547	24.805	13.260	0.431	40.439	-	73.375	25.272	160.566	14.777	5.777	7.174	12.249	-	395.865	5.557
14. Manufacturing, mining and quarrying	285.033	24.718	13.223	0.431	17.094	-	-	0.036	14.535	14.171	4.700	7.113	12.055	-	176.119	0.838
14.1. Mining and quarrying	3.004	-	-	-	-	-	-	0.000	1.227	0.174	0.000	-	-	-	1.603	-
14.2. Manufacture of paper and paper products	41.696	0.002	-	-	12.132	-	-	0.000	0.214	5.791	0.177	-	-	-	23.379	0.001
14.3. Manufacture of industrial chemicals	51.364	6.103	-	-	-	-	-	0.000	0.414	3.477	0.953	6.182	10.793	-	23.165	0.277
14.4. Manufacture of iron, steel and ferro alloys	41.972	13.399	-	-	-	-	-	-	0.345	0.017	0.037	-	0.618	-	27.547	0.009
14.5. Manufacture of aluminium and other non-ferrous metals	71.948	0.062	-	-	-	-	-	-	1.140	0.923	0.799	0.537	0.512	-	67.971	0.004
14.6. Other manufacturing industries	61.395	5.153	-	-	4.961	-	-	0.036	11.195	3.788	2.734	0.394	0.132	-	32.454	0.547
15. Transport	183.786	-	-	-	-	-	72.438	15.699	93.008	0.505	-	0.012	-	-	2.124	-
15.1. Railways and subways	2.968	-	-	-	-	-	-	-	0.844	-	-	-	-	-	2.124	-
15.2. Air transport	15.810	-	-	-	-	-	0.111	15.699	-	-	-	-	-	-	-	-
15.3. Road transport	123.830	-	-	-	-	-	70.604	-	53.214	-	-	0.012	-	-	-	-
15.4. Coastal shipping	41.178	-	-	-	-	-	1.723	-	38.950	0.505	-	-	-	-	-	-
16. Other sectors	310.728	0.087	0.037	-	23.346	-	0.937	9.537	53.023	0.101	1.076	0.049	0.194	-	217.621	4.719
16.1. Fishing	20.780	-	-	-	-	-	0.173	0.017	20.093	0.000	-	-	-	-	0.497	-
16.2. Agriculture	13.480	0.004	-	-	0.070	-	0.030	0.045	6.536	0.084	0.117	-	-	-	6.574	0.020
16.3. Households	165.330	0.079	0.037	-	23.138	-	0.721	6.203	7.631	-	0.184	-	-	-	126.166	1.172
16.4. Other consumers	103.408	0.004	-	-	-	-	-	3.229	13.912	0.017	0.127	0.047	0.194	-	82.351	3.527
16.5 Construction	7.730	-	-	-	0.138	-	0.012	0.043	4.852	-	0.649	0.002	-	-	2.034	-
12. Consumption for non-energy purposes	65.560	2.706	-	13.996	-	-	0.015	0.290	0.127	0.625	31.044	16.757	-	-	-	-
12.1 Manufacture of industrial chemicals	52.013	-	-	4.211	-	-	-	0.002	-	-	31.044	16.757	-	-	-	-
12.2 Other manufacturing	13.546	2.706	-	9.785	-	-	0.015	0.288	0.127	0.625	-	-	-	-	-	-

Annex III

Energy balance	**2000**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	9 321.985	17.757	-	-	45.763	6 481.056	168.535	-	-	-	158.799	1 937.723	-	512.352	-	-
1.1.2 Production of natural gas that is flared off	25.962	-	-	-	-	-	-	-	-	-	-	25.962	-	-	-	-
2. Imports	235.025	25.837	15.472	13.334	0.210	42.508	19.851	9.006	27.991	52.027	23.483	-	-	-	5.306	-
3. Exports	8 244.602	16.117	0.066	0.870	0.002	5 822.033	270.648	8.896	149.147	62.649	76.062	1 764.209	-	-	73.903	-
4.1 Bunkering	34.339	-	-	-	-	-	-	-	19.830	14.508	-	-	-	-	-	-
4.2 Foreign aviation	12.490	-	-	-	-	-	-	12.490	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-27.669	0.618	0.534	0.850	-	-34.965	0.258	1.899	3.611	2.126	-2.599	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 263.872	28.095	15.939	13.315	45.971	666.566	-82.004	-10.482	-137.376	-23.004	103.620	199.476	-	512.352	-68.596	-
8. Energy converted	1 189.604	0.652	1.880	-	6.546	580.249	32.477	1.114	1.091	39.928	11.658	0.103	0.040	512.352	1.513	-
8.1. In blast furnaces	1.880	-	1.880	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	655.575	-	-	-	-	580.249	32.477	1.114	0.306	39.909	1.520	-	-	-	-	-
8.3. In thermal power plants	1.288	-	-	-	1.166	-	-	-	0.115	0.008	-	-	-	-	-	-
8.4. In dual purpose power plants	3.044	0.652	-	-	2.390	-	-	-	0.002	-	-	-	-	-	-	-
8.5. In district heating plants	5.335	-	-	-	2.990	-	-	-	0.669	0.012	0.008	0.103	0.040	-	1.513	-
8.6. In hydropower plants	512.352	-	-	-	-	-	-	-	-	-	-	-	-	512.352	-	-
8.7. Other conversion	10.130	-	-	-	-	-	-	-	-	-	10.130	-	-	-	-	-
1.2. Production of derived energy bearers	1 190.786	-	-	7.365	-	-	192.400	33.562	308.435	66.877	15.091	-	44.772	-	515.423	6.862
9. Consumption by energy sector	198.589	-	-	-	-	-	0.073	-	6.540	0.330	1.472	150.081	28.808	-	11.266	0.019
9.1.1 Crude petroleum and natural gas production	134.926	-	-	-	-	-	-	-	6.348	-	-	124.119	-	-	4.458	-
9.1.2 Natural gas which is flared off on oil fields	25.962	-	-	-	-	-	-	-	-	-	-	25.962	-	-	-	-
9.2. Coal mines	0.144	-	-	-	-	-	-	-	0.102	-	-	-	-	-	0.023	0.019
9.3. Petroleum refineries	32.448	-	-	-	-	-	0.001	-	0.001	0.328	1.472	-	28.808	-	1.838	-
9.4. Pumping storage power plants	2.423	-	-	-	-	-	-	-	-	-	-	-	-	-	2.423	-
9.5. Hydro electric power plants	2.578	-	-	-	-	-	0.072	-	0.071	0.001	-	-	-	-	2.434	-
9.6. Thermal power plants	0.022	-	-	-	-	-	-	-	-	-	-	-	-	-	0.022	-
9.7. Combined heat and power plants	0.005	-	-	-	-	-	-	-	0.005	-	-	-	-	-	-	-
9.8. District heating plants	0.081	-	-	-	-	-	-	-	0.013	-	-	-	-	-	0.068	-
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	42.577	-	-	-	-	-	-	-	-	-	-	1.342	3.493	-	36.270	1.472
11. Statistical differences (7-8+1.2-9-10-13.1)	201.255	0.302	-0.665	7.024	-	86.317	6.690	1.847	19.135	-8.077	65.567	23.118	-	-	-0.000	-0.004
13.1 Net domestic consumption including non-energy use	822.632	27.140	14.724	13.656	39.425	-	71.156	20.119	144.293	11.693	40.013	24.831	12.430	-	397.777	5.374
13. Net domestic consumption	755.796	24.197	14.724	0.418	39.425	-	71.141	19.851	144.167	11.081	7.832	7.378	12.430	-	397.777	5.374
14. Manufacturing, mining and quarrying	290.199	24.116	14.690	0.418	15.406	-	-	0.041	14.294	10.419	6.626	7.259	12.268	-	183.850	0.810
14.1. Mining and quarrying	3.304	-	-	-	-	-	-	0.000	1.281	0.197	0.002	-	-	-	1.823	-
14.2. Manufacture of paper and paper products	42.036	-	-	-	11.574	-	-	0.000	0.190	3.966	0.080	0.051	-	-	26.174	-
14.3. Manufacture of industrial chemicals	55.624	6.276	1.044	-	-	-	-	0.000	0.627	2.302	2.709	6.056	10.947	-	25.386	0.277
14.4. Manufacture of iron, steel and ferro alloys	55.098	13.116	12.774	-	-	-	-	0.000	0.488	0.029	0.073	-	0.605	-	27.995	0.018
14.5. Manufacture of aluminium and other non-ferrous metals	73.961	0.056	0.468	-	-	-	-	0.000	1.205	0.875	0.922	0.717	0.578	-	69.137	0.002
14.6. Other manufacturing industries	60.175	4.668	0.404	0.418	3.832	-	-	0.041	10.502	3.049	2.841	0.435	0.137	-	33.335	0.513
15. Transport	172.696	-	-	-	-	-	70.208	14.345	85.217	0.610	-	0.069	-	-	2.245	-
15.1. Railways and subways	2.970	-	-	-	-	-	-	-	0.725	-	-	-	-	-	2.245	-
15.2. Air transport	14.459	-	-	-	-	-	0.113	14.345	-	-	-	-	-	-	-	-
15.3. Road transport	118.487	-	-	-	-	-	68.372	-	50.093	-	-	0.022	-	-	-	-
15.4. Coastal shipping	36.780	-	-	-	-	-	1.723	-	34.399	0.610	-	0.047	-	-	-	-
16. Other sectors	292.902	0.081	0.034	-	24.019	-	0.932	5.464	44.656	0.052	1.205	0.050	0.163	-	211.682	4.564
16.1. Fishing	19.385	-	-	-	-	-	0.173	0.022	18.696	-	-	-	-	-	0.493	-
16.2. Agriculture	13.193	0.006	-	-	0.070	-	0.025	0.031	5.770	0.019	0.128	-	-	-	7.110	0.034
16.3. Households	160.039	0.072	0.034	-	23.810	-	0.721	4.724	4.867	-	0.290	0.005	-	-	124.661	0.855
16.4. Other consumers	92.539	0.004	-	-	-	-	-	0.667	10.534	0.032	0.134	0.045	0.163	-	77.286	3.674
16.5 Construction	7.747	-	-	-	0.139	-	0.013	0.020	4.790	-	0.654	-	-	-	2.131	-
12. Consumption for non-energy purposes	66.836	2.943	-	13.238	-	-	0.015	0.268	0.126	0.611	32.182	17.453	-	-	-	-
12.1 Manufacture of industrial chemicals	53.872	-	-	4.236	-	-	-	0.002	-	-	32.182	17.453	-	-	-	-
12.2 Other manufacturing	12.965	2.943	-	9.002	-	-	0.015	0.266	0.126	0.611	-	-	-	-	-	-

Annex III

Energy balance	**2001**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	9 523.788	50.243	-	-	48.632	6 461.228	211.246	-	-	-	230.370	2 086.278	-	435.791	-	-
1.1.2 Production of natural gas that is flared off	20.689	-	-	-	-	-	-	-	-	-	-	20.689	-	-	-	-
2. Imports	262.029	23.182	13.679	13.614	0.534	41.416	21.895	10.019	39.604	46.063	13.345	-	-	-	38.680	-
3. Exports	8 597.600	42.075	0.047	0.353	0.002	6 005.759	352.368	4.241	129.513	49.130	159.976	1 828.307	-	-	25.830	-
4.1 Bunkering	34.226	-	-	-	-	-	-	-	19.761	14.465	-	-	-	-	-	-
4.2 Foreign aviation	11.431	-	-	-	-	-	-	11.431	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	66.211	-5.653	0.205	0.591	-	60.141	2.317	3.501	1.894	2.290	0.926	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 229.460	25.697	13.837	13.852	49.164	557.026	-116.910	-2.152	-107.777	-15.242	84.665	278.661	-	435.791	12.850	-
8. Energy converted	1 075.265	0.717	1.320	-	7.065	538.321	30.476	0.741	3.820	41.611	13.142	0.082	0.032	435.791	2.141	0.005
8.1. In blast furnaces	1.320	-	1.320	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	615.679	-	-	-	-	538.321	30.476	0.741	2.755	41.611	1.775	-	-	-	-	-
8.3. In thermal power plants	1.509	-	-	-	1.228	-	-	-	0.281	-	-	-	-	-	-	-
8.4. In dual purpose power plants	2.881	0.717	-	-	2.164	-	-	-	-	-	-	-	-	-	-	-
8.5. In district heating plants	6.751	-	-	-	3.673	-	-	-	0.785	-	0.033	0.082	0.032	-	2.141	0.005
8.6. In hydropower plants	435.791	-	-	-	-	-	-	-	-	-	-	-	-	435.791	-	-
8.7. Other conversion	11.334	-	-	-	-	-	-	-	-	-	11.334	-	-	-	-	-
1.2. Production of derived energy bearers	1 074.341	-	-	7.384	-	-	192.765	26.559	280.595	64.011	13.260	-	42.367	-	439.141	8.259
9. Consumption by energy sector	202.378	-	-	-	-	-	0.065	-	6.628	0.131	1.391	157.383	25.338	-	11.418	0.022
9.1.1 Crude petroleum and natural gas production	147.483	-	-	-	-	-	-	-	6.437	-	-	136.694	-	-	4.352	-
9.1.2 Natural gas which is flared off on oil fields	20.689	-	-	-	-	-	-	-	-	-	-	20.689	-	-	-	-
9.2. Coal mines	0.090	-	-	-	-	-	-	-	-	-	-	-	-	-	0.082	0.008
9.3. Petroleum refineries	28.475	-	-	-	-	-	0.001	-	0.066	0.127	1.391	-	25.338	-	1.552	-
9.4. Pumping storage power plants	2.898	-	-	-	-	-	-	-	-	-	-	-	-	-	2.898	-
9.5. Hydro electric power plants	2.539	-	-	-	-	-	0.064	-	0.065	0.004	-	-	-	-	2.406	-
9.6. Thermal power plants	0.017	-	-	-	-	-	-	-	-	-	-	-	-	-	0.017	-
9.7. Combined heat and power plants	0.005	-	-	-	-	-	-	-	0.005	-	-	-	-	-	-	-
9.8. District heating plants	0.182	-	-	-	-	-	0.000	-	0.056	-	-	-	-	-	0.111	0.014
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	41.556	-	-	-	-	-	-	-	-	-	-	0.507	3.692	-	35.881	1.476
11. Statistical differences (7-8+1.2-9-10-13.1)	126.336	0.962	-0.692	8.464	-	18.704	-28.509	2.440	12.700	-6.567	26.405	92.339	0.059	-	-	0.030
13.1 Net domestic consumption including non-energy use	858.275	24.018	13.208	12.772	42.098	-	73.822	21.226	149.669	13.594	56.986	28.350	13.255	-	402.550	6.727
13. Net domestic consumption	772.514	21.386	13.208	0.201	42.098	-	73.806	20.967	149.549	13.028	8.209	7.528	13.255	-	402.550	6.727
14. Manufacturing, mining and quarrying	281.054	21.336	13.170	0.201	17.032	-	-	0.029	13.714	12.634	6.979	7.160	12.970	-	175.066	0.761
14.1. Mining and quarrying	3.693	-	-	-	0.001	-	-	0.000	1.761	0.188	0.032	0.002	-	-	1.709	-
14.2. Manufacture of paper and paper products	42.353	-	-	-	12.879	-	-	0.000	0.308	5.807	0.066	0.408	-	-	22.885	-
14.3. Manufacture of industrial chemicals	54.926	5.763	1.194	-	-	-	-	0.000	0.600	2.277	3.157	5.275	11.951	-	24.431	0.279
14.4. Manufacture of iron, steel and ferro alloys	48.526	10.935	11.132	-	0.155	-	-	-	0.633	-	0.026	-	0.315	-	25.312	0.018
14.5. Manufacture of aluminium and other non-ferrous metals	73.570	0.059	0.462	-	-	-	-	-	0.877	0.875	0.830	1.063	0.633	-	68.770	-
14.6. Other manufacturing industries	57.985	4.579	0.381	0.201	3.997	-	-	0.029	9.536	3.487	2.869	0.412	0.071	-	31.958	0.464
15. Transport	176.197	-	-	-	-	-	72.861	14.436	86.257	0.250	-	0.102	-	-	2.291	-
15.1. Railways and subways	3.005	-	-	-	-	-	-	-	0.714	-	-	-	-	-	2.291	-
15.2. Air transport	14.547	-	-	-	-	-	0.111	14.436	-	-	-	-	-	-	-	-
15.3. Road transport	126.368	-	-	-	-	-	71.027	-	55.288	-	-	0.054	-	-	-	-
15.4. Coastal shipping	32.276	-	-	-	-	-	1.723	-	30.255	0.250	-	0.048	-	-	-	-
16. Other sectors	315.263	0.049	0.038	-	25.066	-	0.946	6.502	49.579	0.144	1.230	0.266	0.285	-	225.193	5.965
16.1. Fishing	20.139	-	-	-	-	-	0.191	0.026	19.429	0.005	-	-	-	-	0.490	-
16.2. Agriculture	14.519	0.016	-	-	0.070	-	0.022	0.033	6.651	0.009	0.140	-	-	-	7.549	0.029
16.3. Households	167.765	0.030	0.038	-	24.860	-	0.721	5.252	6.148	-	0.306	0.085	-	-	129.154	1.172
16.4. Other consumers	104.329	0.004	-	-	-	-	-	1.169	12.637	0.129	0.140	0.181	0.285	-	85.019	4.765
16.5 Construction	8.511	-	-	-	0.137	-	0.012	0.023	4.714	-	0.644	-	-	-	2.981	-
12. Consumption for non-energy purposes	85.761	2.632	-	12.571	-	-	0.015	0.259	0.119	0.566	48.777	20.822	-	-	-	-
12.1 Manufacture of industrial chemicals	73.870	-	-	4.269	-	-	-	0.002	-	-	48.777	20.822	-	-	-	-
12.2 Other manufacturing	11.891	2.632	-	8.302	-	-	0.015	0.257	0.119	0.566	-	-	-	-	-	-

Annex III

Energy balance	**2002**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	9 785.488	59.901	-	-	50.511	6 197.180	268.103	-	-	-	245.230	2 496.881	-	467.683	-	-
1.1.2 Production of natural gas that is flared off	15.972	-	-	-	-	-	-	-	-	-	-	15.972	-	-	-	-
2. Imports	223.273	18.440	10.547	16.224	1.225	26.828	21.306	12.635	36.354	43.223	17.288	-	-	-	19.203	-
3. Exports	8 876.789	57.639	-	1.819	0.005	5 733.451	353.997	5.043	105.262	62.764	184.243	2 318.400	-	-	54.165	-
4.1 Bunkering	27.444	-	-	-	-	-	-	-	17.997	9.448	-	-	-	-	-	-
4.2 Foreign aviation	10.122	-	-	-	-	-	-	10.122	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-2.096	2.265	0.536	-0.350	-	-4.533	-1.737	1.041	1.819	-2.180	1.042	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 108.282	22.967	11.084	14.055	51.731	486.024	-66.325	-1.488	-85.086	-31.169	79.316	194.452	-	467.683	-34.962	-
8. Energy converted	1 070.487	0.688	1.198	-	7.071	501.554	37.413	1.689	5.186	32.359	13.817	0.079	0.017	467.683	1.726	0.008
8.1. In blast furnaces	1.198	-	1.198	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	578.961	-	-	-	-	501.554	37.413	1.689	3.569	32.253	2.483	-	-	-	-	-
8.3. In thermal power plants	1.275	-	-	-	0.988	-	-	-	0.287	-	-	-	-	-	-	-
8.4. In dual purpose power plants	3.088	0.688	-	-	2.399	-	-	-	-	-	-	-	-	-	0.001	-
8.5. In district heating plants	6.981	-	-	-	3.684	-	-	-	1.330	0.106	0.033	0.079	0.017	-	1.725	0.008
8.6. In hydropower plants	467.683	-	-	-	-	-	-	-	-	-	-	-	-	467.683	-	-
8.7. Other conversion	11.301	-	-	-	-	-	-	-	-	-	11.301	-	-	-	-	-
1.2. Production of derived energy bearers	1 080.250	-	-	6.929	-	-	187.541	28.905	257.071	63.542	13.651	-	43.050	-	470.694	8.866
9. Consumption by energy sector	201.724	-	-	-	-	-	0.042	0.000	5.275	0.143	0.914	158.042	26.570	-	10.715	0.024
9.1.1 Crude petroleum and natural gas production	151.638	-	-	-	-	-	-	-	5.117	-	-	142.066	-	-	4.455	-
9.1.2 Natural gas which is flared off on oil fields	15.972	-	-	-	-	-	-	-	-	-	-	15.972	-	-	-	-
9.2. Coal mines	0.109	-	-	-	-	-	-	-	-	-	-	-	-	-	0.100	0.009
9.3. Petroleum refineries	29.224	-	-	-	-	-	0.001	-	0.066	0.139	0.914	-	26.570	-	1.533	-
9.4. Pumping storage power plants	2.394	-	-	-	-	-	-	-	-	-	-	-	-	-	2.394	-
9.5. Hydro electric power plants	2.207	-	-	-	-	-	0.041	0.000	0.058	0.004	-	-	-	-	2.104	-
9.6. Thermal power plants	0.012	-	-	-	-	-	-	-	-	-	-	-	-	-	0.012	-
9.7. Combined heat and power plants	0.061	-	-	-	-	-	-	-	0.010	-	-	-	-	-	0.051	-
9.8. District heating plants	0.103	-	-	-	-	-	0.000	-	0.024	-	-	-	-	-	0.065	0.014
9.9. Gas supply	0.004	-	-	-	-	-	-	-	-	-	-	0.004	-	-	-	-
10. Losses in transport and distribution	38.880	-	-	-	-	-	-	-	-	-	-	0.407	3.258	-	33.617	1.599
11. Statistical differences (7-8+1.2-9-10-13.1)	38.352	0.994	-1.094	7.391	-	-15.531	10.416	3.444	9.451	-12.094	20.643	14.734	-	-	0.000	-0.001
13.1 Net domestic consumption including non-energy use	839.088	21.285	10.980	13.593	44.661	-	73.345	22.283	152.074	11.966	57.593	21.191	13.205	-	389.675	7.237
13. Net domestic consumption	757.064	18.748	10.980	0.206	44.661	-	73.345	22.281	151.580	11.047	8.333	5.765	13.205	-	389.675	7.237
14. Manufacturing, mining and quarrying	264.965	18.702	10.903	0.206	16.097	-	-	0.031	14.034	10.818	6.871	5.349	12.689	-	168.283	0.984
14.1. Mining and quarrying	3.587	-	-	-	0.008	-	-	0.019	1.713	0.196	0.027	0.006	-	-	1.619	0.000
14.2. Manufacture of paper and paper products	40.935	-	-	-	11.752	-	-	0.000	0.425	5.443	0.081	0.250	-	-	22.982	0.000
14.3. Manufacture of industrial chemicals	48.858	4.510	1.010	-	-	-	-	0.000	0.570	1.984	2.431	3.634	12.303	-	22.125	0.290
14.4. Manufacture of iron, steel and ferro alloys	42.787	9.613	9.380	-	0.187	-	-	-	0.598	0.009	0.088	-	0.234	-	22.662	0.017
14.5. Manufacture of aluminium and other non-ferrous metals	70.704	0.000	0.035	-	0.001	-	-	-	0.739	0.001	1.180	1.034	-	-	67.714	-
14.6. Other manufacturing industries	58.094	4.579	0.477	0.206	4.149	-	-	0.012	9.989	3.185	3.064	0.425	0.152	-	31.181	0.676
15. Transport	174.593	-	-	-	-	-	72.399	12.322	87.241	0.127	0.111	0.127	-	-	2.267	-
15.1. Railways and subways	2.900	-	-	-	-	-	-	-	0.634	-	-	-	-	-	2.267	-
15.2. Air transport	12.497	-	-	-	-	-	0.176	12.322	-	-	-	-	-	-	-	-
15.3. Road transport	127.632	-	-	-	-	-	70.500	-	56.949	-	0.111	0.073	-	-	-	-
15.4. Coastal shipping	31.563	-	-	-	-	-	1.723	-	29.658	0.127	-	0.055	-	-	-	-
16. Other sectors	317.506	0.046	0.077	-	28.564	-	0.946	9.929	50.306	0.103	1.351	0.289	0.516	-	219.125	6.254
16.1. Fishing	21.022	-	-	-	-	-	0.196	0.018	20.281	0.037	-	-	-	-	0.490	-
16.2. Agriculture	13.465	-	-	-	0.070	-	0.017	0.030	5.997	0.037	0.152	-	-	-	7.128	0.033
16.3. Households	167.775	0.042	0.077	-	28.361	-	0.721	5.111	7.027	-	0.426	0.082	-	-	124.729	1.200
16.4. Other consumers	107.164	0.004	-	-	-	-	-	4.749	12.530	-	0.147	0.208	0.516	-	83.988	5.021
16.5 Construction	8.080	-	-	-	0.133	-	0.012	0.020	4.471	0.029	0.626	-	-	-	2.790	-
12. Consumption for non-energy purposes	82.024	2.537	-	13.388	-	-	-	0.002	0.493	0.918	49.260	15.426	-	-	-	-
12.1 Manufacture of industrial chemicals	68.200	-	-	3.214	-	-	-	-	0.300	-	49.260	15.426	-	-	-	-
12.2 Other manufacturing	13.824	2.537	-	10.174	-	-	-	0.002	0.193	0.918	-	-	-	-	-	-

Annex III

Energy balance	**2003**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	9 845.655	82.714	-	-	51.601	5 905.058	366.383	-	-	-	271.858	2 785.353	-	382.687	-	-
1.1.2 Production of natural gas that is flared off	16.208	-	-	-	-	-	-	-	-	-	-	16.208	-	-	-	-
2. Imports	259.679	18.891	10.880	12.791	2.373	26.403	17.565	12.331	33.447	58.329	18.349	-	-	-	48.318	-
3. Exports	8 911.555	75.762	0.001	3.148	0.009	5 372.458	478.375	4.383	117.248	73.350	198.783	2 568.065	-	-	19.975	-
4.1 Bunkering	27.243	-	-	-	-	-	-	-	17.277	9.966	-	-	-	-	-	-
4.2 Foreign aviation	10.227	-	-	-	-	-	-	10.227	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-38.600	-2.980	-0.666	-0.123	-	-28.027	-0.199	-0.247	-2.578	0.839	-4.619	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 133.916	22.862	10.213	9.521	53.965	530.976	-94.625	-2.526	-103.656	-24.148	86.806	233.496	-	382.687	28.344	-
8. Energy converted	1 053.997	0.572	1.141	-	8.988	560.169	36.493	1.083	5.891	41.669	14.100	0.274	0.008	382.687	0.914	0.008
8.1. In blast furnaces	1.141	-	1.141	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	645.046	-	-	-	-	560.169	36.493	1.083	3.300	41.556	2.446	-	-	-	-	-
8.3. In thermal power plants	1.640	-	-	-	1.245	-	-	-	0.375	-	-	0.021	-	-	-	-
8.4. In dual purpose power plants	4.078	0.572	-	-	3.503	-	-	-	-	-	-	-	-	-	0.003	-
8.5. In district heating plants	7.889	-	-	-	4.240	-	-	-	2.216	0.114	0.139	0.253	0.008	-	0.911	0.008
8.6. In hydropower plants	382.687	-	-	-	-	-	-	-	-	-	-	-	-	382.687	-	-
8.7. Other conversion	11.516	-	-	-	-	-	-	-	-	-	11.516	-	-	-	-	-
1.2. Production of derived energy bearers	1 066.020	-	-	7.827	-	-	206.844	31.920	279.016	82.347	16.287	-	45.324	-	386.386	10.069
9. Consumption by energy sector	214.307	-	-	-	-	-	0.041	0.001	5.038	0.048	0.564	166.989	29.401	-	12.206	0.018
9.1.1 Crude petroleum and natural gas production	160.776	-	-	-	-	-	-	-	4.838	-	-	150.758	-	-	5.180	-
9.1.2 Natural gas which is flared off on oil fields	16.208	-	-	-	-	-	-	-	-	-	-	16.208	-	-	-	-
9.2. Coal mines	0.137	-	-	-	-	-	-	-	-	-	-	-	-	-	0.134	0.004
9.3. Petroleum refineries	32.022	-	-	-	-	-	0.001	-	0.059	0.047	0.564	-	29.401	-	1.951	-
9.4. Pumping storage power plants	3.107	-	-	-	-	-	-	-	-	-	-	-	-	-	3.107	-
9.5. Hydro electric power plants	1.758	-	-	-	-	-	0.035	0.000	0.061	0.001	-	-	-	-	1.661	-
9.6. Thermal power plants	0.014	-	-	-	-	-	-	-	-	-	-	-	-	-	0.014	-
9.7. Combined heat and power plants	0.158	-	-	-	-	-	-	-	0.076	-	-	-	-	-	0.082	-
9.8. District heating plants	0.103	-	-	-	-	-	0.005	0.001	0.005	-	-	-	-	-	0.077	0.014
9.9. Gas supply	0.024	-	-	-	-	-	-	-	-	-	-	0.024	-	-	-	-
10. Losses in transport and distribution	33.661	-	-	-	-	-	-	-	-	-	-	0.479	2.322	-	28.620	2.241
11. Statistical differences (7-8+1.2-9-10-13.1)	58.478	1.608	-1.744	4.609	-	-29.192	3.166	8.652	6.581	0.342	27.890	36.567	-	-	-0.000	-0.000
13.1 Net domestic consumption including non-energy use	839.493	20.683	10.816	12.739	44.978	-	72.519	19.657	157.850	16.141	60.540	29.187	13.593	-	372.989	7.801
13. Net domestic consumption	749.836	18.441	10.816	0.171	44.978	-	72.519	19.655	157.357	15.223	8.666	7.628	13.593	-	372.989	7.801
14. Manufacturing, mining and quarrying	270.980	18.403	10.765	0.171	16.425	-	-	0.015	15.899	11.443	7.100	7.068	13.081	-	169.578	1.034
14.1. Mining and quarrying	3.806	-	-	-	0.000	-	-	0.005	1.877	0.198	0.051	0.012	-	-	1.663	0.000
14.2. Manufacture of paper and paper products	40.618	-	-	-	12.037	-	-	0.000	0.670	5.635	0.325	0.228	-	-	21.722	0.001
14.3. Manufacture of industrial chemicals	52.424	4.919	1.059	-	0.013	-	-	0.000	0.622	2.177	2.412	5.467	12.975	-	22.441	0.340
14.4. Manufacture of iron, steel and ferro alloys	39.787	8.689	9.242	-	0.200	-	-	0.000	0.813	0.016	0.071	-	0.064	-	20.678	0.015
14.5. Manufacture of aluminium and other non-ferrous metals	77.534	0.000	-	-	-	-	-	-	1.097	0.000	1.202	1.079	-	-	74.156	-
14.6. Other manufacturing industries	56.811	4.795	0.463	0.171	4.175	-	-	0.009	10.821	3.418	3.039	0.282	0.042	-	28.918	0.678
15. Transport	178.823	-	-	-	-	-	71.585	12.910	88.432	3.317	0.069	0.279	-	-	2.231	-
15.1. Railways and subways	2.838	-	-	-	-	-	-	-	0.607	-	-	-	-	-	2.231	-
15.2. Air transport	13.058	-	-	-	-	-	0.148	12.910	-	-	-	-	-	-	-	-
15.3. Road transport	130.615	-	-	-	-	-	69.714	-	60.730	-	0.069	0.102	-	-	-	-
15.4. Coastal shipping	32.312	-	-	-	-	-	1.723	-	27.095	3.317	-	0.177	-	-	-	-
16. Other sectors	300.032	0.038	0.051	-	28.553	-	0.934	6.730	53.027	0.462	1.497	0.281	0.512	-	201.180	6.767
16.1. Fishing	20.387	-	-	-	-	-	0.189	0.006	19.567	0.136	-	-	-	-	0.490	-
16.2. Agriculture	13.159	-	-	-	0.070	-	0.012	0.034	6.383	0.052	0.166	0.010	-	-	6.404	0.028
16.3. Households	159.709	0.034	0.051	-	28.177	-	0.721	5.879	7.578	-	0.554	0.085	-	-	115.283	1.349
16.4. Other consumers	99.290	0.004	-	-	0.174	-	-	0.791	15.175	0.264	0.155	0.187	0.512	-	76.638	5.391
16.5 Construction	7.486	-	-	-	0.132	-	0.012	0.020	4.325	0.011	0.622	-	-	-	2.365	-
12. Consumption for non-energy purposes	89.657	2.242	-	12.569	-	-	-	0.002	0.493	0.918	51.874	21.559	-	-	-	-
12.1 Manufacture of industrial chemicals	75.913	-	-	2.180	-	-	-	-	0.300	-	51.874	21.559	-	-	-	-
12.2 Other manufacturing	13.743	2.242	-	10.388	-	-	-	0.002	0.193	0.918	-	-	-	-	-	-

Annex III

Energy balance	**2004**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	9 905.265	81.611	-	-	50.601	5 842.637	331.666	-	-	-	280.219	2 924.176	-	394.355	-	-
1.1.2 Production of natural gas that is flared off	18.470	-	-	-	-	-	-	-	-	-	-	18.470	-	-	-	-
2. Imports	268.472	21.519	13.034	12.354	1.357	21.175	24.170	11.397	34.702	57.724	15.928	-	-	-	55.112	-
3. Exports	8 907.262	77.026	0.006	0.652	0.013	5 261.421	420.222	3.822	117.757	70.709	186.860	2 754.902	-	-	13.875	-
4.1 Bunkering	26.040	-	-	-	-	-	-	-	15.833	10.207	-	-	-	-	-	-
4.2 Foreign aviation	11.588	-	-	-	-	-	-	11.588	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	15.227	-0.426	0.122	0.367	-	6.411	4.570	-0.810	2.809	0.643	1.541	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 262.544	25.678	13.150	12.069	51.944	608.803	-59.816	-4.823	-96.078	-22.549	110.829	187.744	-	394.355	41.237	-
8. Energy converted	1 039.601	0.765	1.846	-	9.297	532.572	34.965	0.815	4.995	44.032	13.430	0.314	0.019	394.355	2.190	0.006
8.1. In blast furnaces	1.846	-	1.846	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	618.503	-	-	-	-	532.572	34.965	0.815	3.828	43.991	2.333	-	-	-	-	-
8.3. In thermal power plants	1.720	-	-	-	1.271	-	-	-	0.330	-	-	0.120	-	-	-	-
8.4. In dual purpose power plants	4.255	0.765	-	-	3.490	-	-	-	-	-	-	-	-	-	-	-
8.5. In district heating plants	7.885	-	-	-	4.537	-	-	-	0.837	0.042	0.059	0.194	0.019	-	2.190	0.006
8.6. In hydropower plants	394.355	-	-	-	-	-	-	-	-	-	-	-	-	394.355	-	-
8.7. Other conversion	11.038	-	-	-	-	-	-	-	-	-	11.038	-	-	-	-	-
1.2. Production of derived energy bearers	1 057.210	-	-	6.052	-	-	202.912	28.881	272.797	78.155	15.408	-	44.067	-	398.330	10.609
9. Consumption by energy sector	222.000	-	-	-	-	-	0.048	0.000	5.256	0.068	0.495	175.979	27.708	-	12.427	0.018
9.1.1 Crude petroleum and natural gas production	168.216	-	-	-	-	-	-	-	5.077	-	-	157.473	-	-	5.666	-
9.1.2 Natural gas which is flared off on oil fields	18.470	-	-	-	-	-	-	-	-	-	-	18.470	-	-	-	-
9.2. Coal mines	0.136	-	-	-	-	-	0.007	-	-	-	-	-	-	-	0.125	0.004
9.3. Petroleum refineries	30.242	-	-	-	-	-	0.001	-	0.078	0.068	0.495	-	27.708	-	1.892	-
9.4. Pumping storage power plants	2.621	-	-	-	-	-	-	-	-	-	-	-	-	-	2.621	-
9.5. Hydro electric power plants	2.037	-	-	-	-	-	0.035	0.000	0.064	-	-	-	-	-	1.939	-
9.6. Thermal power plants	0.018	-	-	-	-	-	-	-	-	-	-	-	-	-	0.018	-
9.7. Combined heat and power plants	0.122	-	-	-	-	-	-	-	0.030	-	-	-	-	-	0.092	-
9.8. District heating plants	0.102	-	-	-	-	-	0.005	-	0.008	-	-	-	-	-	0.075	0.014
9.9. Gas supply	0.036	-	-	-	-	-	-	-	-	-	-	0.036	-	-	-	-
10. Losses in transport and distribution	39.001	-	-	-	-	-	-	-	-	-	-	0.489	2.721	-	33.602	2.189
11. Statistical differences (7-8+1.2-9-10-13.1)	166.472	1.905	-1.265	5.816	-	76.231	35.955	2.412	11.097	-4.193	61.275	-22.761	-	-	0.000	-0.000
13.1 Net domestic consumption including non-energy use	852.680	23.009	12.569	12.305	42.647	-	72.128	20.832	155.370	15.698	51.037	33.723	13.619	-	391.347	8.396
13. Net domestic consumption	770.524	20.709	12.569	0.059	42.647	-	72.128	20.829	154.877	14.780	9.642	8.921	13.619	-	391.347	8.396
14. Manufacturing, mining and quarrying	285.514	20.649	12.546	0.059	15.705	-	-	0.014	13.315	10.758	7.899	7.934	13.130	-	182.476	1.029
14.1. Mining and quarrying	4.218	-	-	-	0.000	-	-	0.000	2.209	0.134	0.034	0.095	0.038	-	1.708	0.001
14.2. Manufacture of paper and paper products	40.997	-	-	-	11.296	-	-	-	0.509	5.761	0.252	0.376	-	-	22.802	0.001
14.3. Manufacture of industrial chemicals	54.279	5.885	1.094	-	0.010	-	-	-	0.488	1.912	3.459	5.321	12.459	-	23.334	0.316
14.4. Manufacture of iron, steel and ferro alloys	47.055	10.749	10.937	-	0.215	-	-	0.000	0.491	-	0.062	0.037	0.454	-	24.094	0.017
14.5. Manufacture of aluminium and other non-ferrous metals	83.611	-	-	0.002	-	-	-	-	0.725	0.000	1.045	1.135	-	-	80.703	-
14.6. Other manufacturing industries	55.353	4.016	0.515	0.057	4.184	-	-	0.014	8.891	2.951	3.048	0.970	0.178	-	29.836	0.694
15. Transport	183.882	-	-	-	-	-	71.191	12.760	93.769	3.573	0.081	0.380	-	-	2.129	-
15.1. Railways and subways	2.767	-	-	-	-	-	-	-	0.639	-	-	-	-	-	2.129	-
15.2. Air transport	12.938	-	-	-	-	-	0.179	12.760	-	-	-	-	-	-	-	-
15.3. Road transport	135.456	-	-	-	-	-	69.289	-	65.988	-	0.081	0.099	-	-	-	-
15.4. Coastal shipping	32.720	-	-	-	-	-	1.723	-	27.142	3.573	-	0.282	-	-	-	-
16. Other sectors	301.129	0.060	0.023	-	26.942	-	0.937	8.056	47.794	0.449	1.662	0.607	0.489	-	206.742	7.368
16.1. Fishing	19.945	-	-	-	-	-	0.191	0.004	19.078	0.182	-	-	-	-	0.490	-
16.2. Agriculture	13.937	-	-	-	0.070	-	0.013	0.027	6.282	0.056	0.182	0.242	-	-	7.052	0.013
16.3. Households	156.683	0.056	0.023	-	26.491	-	0.721	5.021	5.469	-	0.622	0.120	-	-	116.658	1.502
16.4. Other consumers	103.252	0.004	-	-	0.244	-	-	2.987	12.459	0.193	0.212	0.245	0.489	-	80.566	5.852
16.5 Construction	7.312	-	-	-	0.137	-	0.012	0.016	4.505	0.018	0.646	-	-	-	1.976	-
12. Consumption for non-energy purposes	82.156	2.300	-	12.245	-	-	-	0.002	0.493	0.918	41.395	24.802	-	-	-	-
12.1 Manufacture of industrial chemicals	68.150	-	-	1.653	-	-	-	-	0.300	-	41.395	24.802	-	-	-	-
12.2 Other manufacturing	14.005	2.300	-	10.592	-	-	-	0.002	0.193	0.918	-	-	-	-	-	-

Annex III

Energy balance	**2005**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	9 674.919	41.330	-	-	54.987	5 319.737	340.482	-	-	-	289.582	3 135.778	-	493.024	-	-
1.1.2 Production of natural gas that is flared off	16.912	-	-	-	-	-	-	-	-	-	-	16.912	-	-	-	-
2. Imports	235.994	18.753	10.883	12.641	0.881	45.186	22.008	7.024	24.931	69.276	11.261	-	-	-	13.150	-
3. Exports	8 642.393	46.811	0.071	0.234	0.009	4 730.042	430.829	6.567	106.053	70.162	223.774	2 971.337	-	-	56.503	-
4.1 Bunkering	29.900	-	-	-	-	-	-	-	17.658	12.242	-	-	-	-	-	-
4.2 Foreign aviation	14.777	-	-	-	-	-	-	14.777	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-18.210	9.068	-0.674	-0.174	-	-16.673	-3.045	0.205	-4.760	-1.750	-0.406	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 222.544	22.340	10.139	12.233	55.858	618.208	-71.384	-14.117	-103.540	-14.879	76.663	181.352	-	493.024	-43.352	-
8. Energy converted	1 200.176	0.708	1.461	-	9.473	565.353	53.549	0.357	5.458	55.157	12.519	0.542	0.032	493.024	2.524	0.021
8.1. In blast furnaces	1.461	-	1.461	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	680.826	-	-	-	-	565.353	53.549	0.357	4.631	55.157	1.779	-	-	-	-	-
8.3. In thermal power plants	1.961	-	-	-	1.415	-	-	-	0.293	-	-	0.253	-	-	-	-
8.4. In dual purpose power plants	4.147	0.708	-	-	3.433	-	-	-	0.006	-	-	-	-	-	0.001	-
8.5. In district heating plants	8.052	-	-	-	4.625	-	-	-	0.528	-	0.034	0.289	0.032	-	2.524	0.021
8.6. In hydropower plants	493.024	-	-	-	-	-	-	-	-	-	-	-	-	493.024	-	-
8.7. Other conversion	10.706	-	-	-	-	-	-	-	-	-	10.706	-	-	-	-	-
1.2. Production of derived energy bearers	1 221.078	-	-	7.923	-	-	239.250	34.315	299.238	68.838	17.707	-	45.921	-	496.818	11.067
9. Consumption by energy sector	222.982	-	-	-	-	-	0.066	0.000	4.757	-	-	170.985	30.819	-	16.339	0.015
9.1.1 Crude petroleum and natural gas production	166.488	-	-	-	-	-	-	-	4.554	-	-	154.015	-	-	7.919	-
9.1.2 Natural gas which is flared off on oil fields	16.912	-	-	-	-	-	-	-	-	-	-	16.912	-	-	-	-
9.2. Coal mines	0.130	-	-	-	-	-	0.021	-	-	-	-	-	-	-	0.107	0.002
9.3. Petroleum refineries	32.928	-	-	-	-	-	0.001	-	0.092	-	-	-	30.819	-	2.017	-
9.4. Pumping storage power plants	3.928	-	-	-	-	-	-	-	-	-	-	-	-	-	3.928	-
9.5. Hydro electric power plants	2.258	-	-	-	-	-	0.039	0.000	0.073	-	-	-	-	-	2.146	-
9.6. Thermal power plants	0.016	-	-	-	-	-	-	-	-	-	-	-	-	-	0.016	-
9.7. Combined heat and power plants	0.150	-	-	-	-	-	-	-	0.026	-	-	-	-	-	0.124	-
9.8. District heating plants	0.114	-	-	-	-	-	0.005	-	0.013	-	-	-	-	-	0.084	0.013
9.9. Gas supply	0.059	-	-	-	-	-	-	-	-	-	-	0.059	-	-	-	-
10. Losses in transport and distribution	40.375	-	-	-	-	-	-	-	-	-	-	0.342	1.845	-	35.982	2.206
11. Statistical differences (7-8+1.2-9-10-13.1)	129.332	2.081	-2.157	6.784	-	52.854	44.775	1.721	29.237	-15.476	31.032	-21.520	-	-	-0.000	-0.000
13.1 Net domestic consumption including non-energy use	850.757	19.551	10.834	13.373	46.386	-	69.476	18.121	156.247	14.279	50.818	31.002	13.225	-	398.620	8.825
13. Net domestic consumption	769.719	17.182	10.834	0.050	46.386	-	69.476	18.118	155.754	13.360	8.657	9.231	13.225	-	398.620	8.825
14. Manufacturing, mining and quarrying	281.208	17.172	10.803	0.050	17.606	-	-	0.026	12.170	10.493	6.865	7.669	12.526	-	184.749	1.077
14.1. Mining and quarrying	4.037	-	-	-	0.000	-	-	0.009	2.027	0.063	0.057	0.179	0.065	-	1.638	0.000
14.2. Manufacture of paper and paper products	40.819	-	-	-	11.808	-	-	-	0.222	5.314	0.149	0.297	-	-	23.028	0.001
14.3. Manufacture of industrial chemicals	53.395	5.205	1.025	-	0.470	-	-	-	0.485	2.283	2.423	4.140	12.020	-	25.010	0.334
14.4. Manufacture of iron, steel and ferro alloys	38.481	8.699	9.271	-	-	-	-	-	0.472	-	0.016	0.066	0.309	-	19.614	0.033
14.5. Manufacture of aluminium and other non-ferrous metals	88.705	-	-	-	-	-	-	-	0.535	-	0.985	1.652	-	-	85.526	0.007
14.6. Other manufacturing industries	55.771	3.269	0.507	0.050	5.328	-	-	0.017	8.429	2.834	3.235	1.335	0.133	-	29.932	0.702
15. Transport	184.589	-	-	-	-	-	68.536	10.777	100.305	2.323	0.081	0.405	-	-	2.161	-
15.1. Railways and subways	2.774	-	-	-	-	-	-	-	0.613	-	-	-	-	-	2.161	-
15.2. Air transport	10.878	-	-	-	-	-	0.101	10.777	-	-	-	-	-	-	-	-
15.3. Road transport	135.954	-	-	-	-	-	66.712	-	69.093	-	0.081	0.069	-	-	-	-
15.4. Coastal shipping	34.982	-	-	-	-	-	1.723	-	30.599	2.323	-	0.337	-	-	-	-
16. Other sectors	303.922	0.010	0.031	-	28.779	-	0.939	7.316	43.278	0.544	1.711	1.156	0.699	-	211.710	7.748
16.1. Fishing	19.187	-	-	-	-	-	0.190	0.005	18.269	0.162	-	-	-	-	0.562	-
16.2. Agriculture	14.428	-	-	-	0.070	-	0.015	0.022	6.258	0.054	0.199	0.661	-	-	7.146	0.004
16.3. Households	162.269	0.006	0.031	-	28.347	-	0.721	4.293	4.074	-	0.622	0.216	-	-	122.422	1.537
16.4. Other consumers	99.886	0.004	-	-	0.218	-	-	2.982	9.935	0.324	0.212	0.269	0.699	-	79.036	6.207
16.5 Construction	8.152	-	-	-	0.144	-	0.013	0.014	4.743	0.004	0.678	0.011	-	-	2.545	-
12. Consumption for non-energy purposes	81.038	2.369	-	13.323	-	-	-	0.002	0.493	0.918	42.161	21.772	-	-	-	-
12.1 Manufacture of industrial chemicals	65.959	-	-	1.726	-	-	-	-	0.300	-	42.161	21.772	-	-	-	-
12.2 Other manufacturing	15.080	2.369	-	11.597	-	-	-	0.002	0.193	0.918	-	-	-	-	-	-

Annex III

Energy balance	**2006**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	9 323.007	67.298	-	-	52.840	4 935.955	351.799	-	-	-	266.518	3 215.282	-	433.314	-	-
1.1.2 Production of natural gas that is flared off	15.604	-	-	-	-	-	-	-	-	-	-	15.604	-	-	-	-
2. Imports	240.319	14.848	11.148	13.268	1.561	16.245	14.918	10.479	39.561	71.857	11.150	-	-	-	35.286	-
3. Exports	8 274.300	63.675	0.001	0.353	0.059	4 231.469	439.420	10.271	127.652	88.493	245.696	3 035.002	-	-	32.209	-
4.1 Bunkering	29.854	-	-	-	-	-	-	-	16.877	12.977	-	-	-	-	-	-
4.2 Foreign aviation	17.025	-	-	-	-	-	-	17.025	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-17.801	-0.559	0.817	0.368	-	-11.821	-2.844	0.355	-2.379	2.035	-3.774	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 239.950	17.912	11.964	13.282	54.343	708.910	-75.547	-16.462	-107.347	-27.578	28.198	195.885	-	433.314	3.077	-
8. Energy converted	1 181.214	0.693	1.827	-	9.838	598.643	56.975	0.231	4.957	56.820	14.930	0.737	0.022	433.314	2.224	0.004
8.1. In blast furnaces	1.827	-	1.827	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	717.866	-	-	-	-	598.643	56.975	0.231	3.833	56.820	1.365	-	-	-	-	-
8.3. In thermal power plants	1.965	-	-	-	1.334	-	-	-	0.336	-	-	0.295	-	-	-	-
8.4. In dual purpose power plants	4.113	0.693	-	-	3.420	-	-	-	-	-	-	-	-	-	-	-
8.5. In district heating plants	8.702	-	-	-	5.085	-	-	-	0.788	-	0.139	0.442	0.022	-	2.224	0.004
8.6. In hydropower plants	433.314	-	-	-	-	-	-	-	-	-	-	-	-	433.314	-	-
8.7. Other conversion	13.427	-	-	-	-	-	-	-	-	-	13.427	-	-	-	-	-
1.2. Production of derived energy bearers	1 203.152	-	-	7.390	-	-	246.264	38.004	310.208	82.728	19.177	-	50.130	-	437.537	11.714
9. Consumption by energy sector	226.604	-	-	-	-	-	0.056	0.001	5.401	-	0.001	174.149	31.549	-	15.427	0.019
9.1.1 Crude petroleum and natural gas production	173.293	-	-	-	-	-	-	-	5.242	-	-	158.545	-	-	9.506	-
9.1.2 Natural gas which is flared off on oil fields	15.604	-	-	-	-	-	-	-	-	-	-	15.604	-	-	-	-
9.2. Coal mines	0.150	-	-	-	-	-	0.018	-	0.003	-	-	-	-	-	0.129	-
9.3. Petroleum refineries	33.420	-	-	-	-	-	0.001	-	0.089	-	-	-	31.549	-	1.782	-
9.4. Pumping storage power plants	1.854	-	-	-	-	-	-	-	-	-	-	-	-	-	1.854	-
9.5. Hydro electric power plants	2.013	-	-	-	-	-	0.033	0.001	0.041	-	-	-	-	-	1.938	-
9.6. Thermal power plants	0.017	-	-	-	-	-	-	-	-	-	-	-	-	-	0.017	-
9.7. Combined heat and power plants	0.105	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.086	-
9.8. District heating plants	0.147	-	-	-	-	-	0.005	-	0.007	-	0.001	-	-	-	0.115	0.019
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	41.005	-	-	-	-	-	-	-	-	-	-	0.407	2.068	-	36.263	2.268
11. Statistical differences (7-8+1.2-9-10-13.1)	146.771	0.606	0.675	6.363	-0.000	110.267	46.847	2.596	27.448	-18.249	-18.135	-11.646	-	-	-0.001	-
13.1 Net domestic consumption including non-energy use	847.508	16.613	9.462	14.309	44.504	-	66.838	18.714	165.055	16.579	50.580	32.238	16.491	-	386.701	9.424
13. Net domestic consumption	766.208	14.551	9.462	0.057	44.504	-	66.838	18.712	164.562	15.661	9.298	9.948	16.491	-	386.701	9.424
14. Manufacturing, mining and quarrying	274.813	14.533	9.446	0.057	17.186	-	-	0.018	12.698	11.141	7.442	8.235	15.862	-	177.119	1.075
14.1. Mining and quarrying	4.205	-	-	-	0.000	-	-	0.002	2.168	0.056	0.060	0.186	0.126	-	1.606	0.000
14.2. Manufacture of paper and paper products	39.028	-	-	-	11.375	-	-	-	0.223	6.010	0.205	0.342	-	-	20.868	0.005
14.3. Manufacture of industrial chemicals	53.928	3.200	0.916	-	0.471	-	-	-	0.381	2.139	2.547	4.156	15.138	-	24.660	0.322
14.4. Manufacture of iron, steel and ferro alloys	31.247	7.719	8.008	-	-	-	-	0.003	0.375	-	0.011	0.099	0.415	-	14.573	0.043
14.5. Manufacture of aluminium and other non-ferrous metals	88.374	-	-	0.001	-	-	-	-	0.423	-	1.020	1.910	-	-	85.003	0.017
14.6. Other manufacturing industries	58.031	3.614	0.522	0.056	5.340	-	-	0.013	9.129	2.936	3.599	1.543	0.183	-	30.408	0.688
15. Transport	193.036	-	-	-	0.215	-	65.895	11.694	108.677	3.699	0.081	0.439	-	-	2.335	-
15.1. Railways and subways	2.930	-	-	-	0.002	-	-	-	0.593	-	-	-	-	-	2.335	-
15.2. Air transport	11.773	-	-	-	-	-	0.079	11.694	-	-	-	-	-	-	-	-
15.3. Road transport	142.475	-	-	-	0.213	-	64.094	-	77.982	-	0.081	0.106	-	-	-	-
15.4. Coastal shipping	35.857	-	-	-	-	-	1.723	-	30.102	3.699	-	0.333	-	-	-	-
16. Other sectors	298.359	0.018	0.016	-	27.104	-	0.943	6.999	43.188	0.820	1.775	1.273	0.629	-	207.246	8.349
16.1. Fishing	18.119	-	-	-	-	-	0.195	0.003	17.093	0.291	-	-	-	-	0.537	-
16.2. Agriculture	14.052	-	-	-	0.070	-	0.013	0.021	6.128	0.081	0.237	0.655	-	-	6.840	0.007
16.3. Households	159.747	0.014	0.016	-	26.548	-	0.721	4.287	4.466	-	0.622	0.140	-	-	121.126	1.806
16.4. Other consumers	98.089	0.004	-	-	0.331	-	-	2.673	10.614	0.449	0.212	0.467	0.629	-	76.174	6.535
16.5 Construction	8.354	-	-	-	0.154	-	0.014	0.014	4.886	-	0.704	0.012	-	-	2.570	-
12. Consumption for non-energy purposes	81.300	2.062	-	14.252	-	-	-	0.002	0.493	0.918	41.283	22.290	-	-	-	-
12.1 Manufacture of industrial chemicals	64.959	-	-	1.086	-	-	-	-	0.300	-	41.283	22.290	-	-	-	-
12.2 Other manufacturing	16.341	2.062	-	13.166	-	-	-	0.002	0.193	0.918	-	-	-	-	-	-

Annex III

Energy balance	**2007**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and w ind pow er	Electricity	District heating
1.1.1 Production of primary energy bearers	8 997.738	114.461	-	-	53.933	4 603.830	181.023	-	-	-	285.504	3 270.728	-	488.261	-	-
1.1.2 Production of natural gas that is flared off	37.441	-	-	-	-	-	-	-	-	-	-	37.441	-	-	-	-
2. Imports	256.888	17.139	12.595	12.684	2.639	61.205	15.199	8.422	35.481	67.580	4.921	-	-	-	19.024	-
3. Exports	8 131.440	94.716	-	1.238	0.030	4 116.977	340.020	9.543	120.842	88.631	238.820	3 065.470	-	-	55.152	-
4.1 Bunkering	27.456	-	-	-	-	-	-	-	16.506	10.950	-	-	-	-	-	-
4.2 Foreign aviation	15.845	-	-	-	-	-	-	15.845	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	19.861	-15.613	-0.137	0.133	-	36.904	0.004	-0.898	-0.282	-0.929	0.680	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 137.186	21.270	12.458	11.579	56.542	584.961	-143.795	-17.864	-102.149	-32.931	52.285	242.698	-	488.261	-36.129	-
8. Energy converted	1 235.761	0.748	2.189	-	10.751	602.472	48.009	2.020	6.463	53.904	12.433	5.281	0.589	488.261	2.639	0.004
8.1. In blast furnaces	2.189	-	2.189	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	713.099	-	-	-	-	602.472	48.009	2.020	5.453	53.904	1.240	-	-	-	-	-
8.3. In thermal pow er plants	7.107	-	-	-	1.600	-	-	-	0.172	-	-	4.766	0.567	-	-	-
8.4. In dual purpose pow er plants	4.577	0.748	-	-	3.825	-	-	-	0.005	-	-	-	-	-	-	-
8.5. In district heating plants	9.431	-	-	-	5.326	-	-	-	0.832	-	0.095	0.515	0.021	-	2.639	0.004
8.6. In hydropow er plants	488.261	-	-	-	-	-	-	-	-	-	-	-	-	488.261	-	-
8.7. Other conversion	11.098	-	-	-	-	-	-	-	-	-	11.098	-	-	-	-	-
1.2. Production of derived energy bearers	1 253.366	-	-	7.301	-	-	248.571	36.552	300.770	87.280	19.327	-	46.883	-	493.790	12.892
9. Consumption by energy sector	255.401	-	-	-	-	-	0.042	-	7.441	-	0.001	196.932	30.547	-	20.395	0.042
9.1.1 Crude petroleum and natural gas production	176.917	-	-	-	-	-	-	-	6.896	-	-	159.492	-	-	10.529	-
9.1.2 Natural gas w hich is flared off on oil fields	37.441	-	-	-	-	-	-	-	-	-	-	37.441	-	-	-	-
9.2. Coal mines	0.172	-	-	-	-	-	-	-	0.025	-	-	-	-	-	0.147	-
9.3. Petroleum refineries	32.785	-	-	-	-	-	0.000	-	0.153	-	-	-	30.547	-	2.085	-
9.4. Pumping storage pow er plants	5.555	-	-	-	-	-	-	-	-	-	-	-	-	-	5.555	-
9.5. Hydro electric pow er plants	2.054	-	-	-	-	-	0.036	-	0.116	-	-	-	-	-	1.902	-
9.6. Thermal pow er plants	0.246	-	-	-	-	-	-	-	0.226	-	-	-	-	-	0.020	-
9.7. Combined heat and pow er plants	0.106	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.087	-
9.8. District heating plants	0.126	-	-	-	-	-	0.005	-	0.007	-	0.001	-	-	-	0.070	0.042
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	42.598	-	-	-	-	-	-	-	-	-	-	0.944	2.911	-	36.284	2.458
11. Statistical differences (7-8+1.2-9-10-13.1)	-6.301	2.313	-0.203	5.429	-	-17.511	-6.676	-2.307	14.519	-14.669	2.231	10.573	-	-	0.000	-0.000
13.1 Net domestic consumption including non-energy use	863.093	18.209	10.472	13.450	45.791	-	63.400	18.975	170.198	15.114	56.948	28.968	12.836	-	398.343	10.388
13. Net domestic consumption	780.123	15.831	10.472	0.304	45.791	-	63.400	18.973	169.705	14.196	9.166	10.719	12.836	-	398.343	10.388
14. Manufacturing, mining and quarrying	268.003	15.818	10.415	0.304	17.873	-	-	0.019	10.938	8.694	7.160	7.537	12.094	-	176.029	1.120
14.1. Mining and quarrying	4.228	-	-	-	0.000	-	-	0.018	2.196	0.048	0.040	0.179	0.063	-	1.679	0.005
14.2. Manufacture of paper and paper products	37.917	-	-	-	12.020	-	-	-	0.198	4.403	0.120	0.164	0.025	-	20.988	-
14.3. Manufacture of industrial chemicals	52.705	5.336	2.587	-	0.773	-	-	-	0.439	1.601	2.322	2.969	11.421	-	24.821	0.437
14.4. Manufacture of iron, steel and ferro alloys	32.270	6.870	7.241	-	-	-	-	0.000	0.383	-	0.037	0.066	0.404	-	17.262	0.007
14.5. Manufacture of aluminium and other non-ferrous metals	85.792	-	-	-	-	-	-	-	0.433	0.006	1.036	2.119	-	-	82.139	0.060
14.6. Other manufacturing industries	55.090	3.612	0.587	0.304	5.081	-	-	0.001	7.290	2.636	3.606	2.040	0.181	-	29.141	0.612
15. Transport	203.083	-	-	-	1.186	-	62.440	13.589	116.972	4.827	0.081	1.694	-	-	2.294	-
15.1. Railw ays and subw ays	2.909	-	-	-	0.008	-	-	-	0.607	-	-	-	-	-	2.294	-
15.2. Air transport	13.660	-	-	-	-	-	0.071	13.589	-	-	-	-	-	-	-	-
15.3. Road transport	148.337	-	-	-	1.178	-	60.646	-	86.323	-	0.081	0.109	-	-	-	-
15.4. Coastal shipping	38.177	-	-	-	-	-	1.723	-	30.041	4.827	-	1.586	-	-	-	-
16. Other sectors	309.037	0.012	0.057	-	26.732	-	0.960	5.364	41.795	0.675	1.925	1.488	0.742	-	220.020	9.268
16.1. Fishing	17.482	-	-	-	-	-	0.206	0.003	16.566	0.178	-	-	-	-	0.529	-
16.2. Agriculture	14.028	-	-	-	0.049	-	0.009	0.017	6.044	0.072	0.245	0.614	-	-	6.970	0.010
16.3. Households	162.534	0.008	0.011	-	26.089	-	0.721	3.347	3.808	-	0.541	0.149	-	-	125.813	2.047
16.4. Other consumers	105.713	0.004	0.046	-	0.397	-	0.008	1.985	9.891	0.414	0.334	0.712	0.742	-	83.968	7.211
16.5 Construction	9.280	-	-	-	0.197	-	0.016	0.013	5.486	0.010	0.806	0.013	-	-	2.740	-
12. Consumption for non-energy purposes	82.970	2.379	-	13.146	-	-	-	0.002	0.493	0.918	47.782	18.249	-	-	-	-
12.1 Manufacture of industrial chemicals	65.529	-	-	1.032	-	-	-	-	0.245	-	46.002	18.249	-	-	-	-
12.2 Other manufacturing	17.441	2.379	-	12.114	-	-	-	0.002	0.248	0.918	1.780	-	-	-	-	-

Annex III

Energy balance	**2008**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	9 176.776	96.390	-	-	54.798	4 383.350	211.115	-	-	-	279.592	3 644.311	-	507.218	-	-
1.1.2 Production of natural gas that is flared off	33.214	-	-	-	-	-	-	-	-	-	-	33.214	-	-	-	-
2. Imports	240.113	18.102	12.978	17.469	4.559	35.054	19.574	10.891	40.705	60.263	8.235	-	-	-	12.282	-
3. Exports	8 162.636	94.101	-	0.248	0.023	3 770.688	310.504	12.064	105.105	110.868	258.831	3 438.013	-	-	62.190	-
4.1 Bunkering	27.495	-	-	-	-	-	-	-	16.174	11.321	-	-	-	-	-	-
4.2 Foreign aviation	15.739	-	-	-	-	-	-	15.739	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-15.630	2.846	-0.198	-0.321	-	-16.577	-0.634	-1.131	0.646	-1.112	0.851	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 228.602	23.237	12.780	16.899	59.334	631.140	-80.450	-18.043	-79.928	-63.038	29.848	239.513	-	507.218	-49.908	-
8. Energy converted	1 200.022	0.626	2.024	-	11.624	551.102	44.187	0.338	16.498	47.404	12.752	3.174	0.649	507.218	2.419	0.007
8.1. In blast furnaces	2.024	-	2.024	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	660.146	-	-	-	-	551.102	44.187	0.338	15.813	47.404	1.302	-	-	-	-	-
8.3. In thermal power plants	4.851	-	-	-	1.626	-	-	-	0.090	-	-	2.505	0.630	-	-	-
8.4. In dual purpose power plants	4.835	0.626	-	-	4.145	-	-	-	0.056	-	-	-	-	-	0.007	-
8.5. In district heating plants	9.690	-	-	-	5.853	-	-	-	0.538	-	0.192	0.669	0.019	-	2.412	0.007
8.6. In hydropower plants	507.218	-	-	-	-	-	-	-	-	-	-	-	-	507.218	-	-
8.7. Other conversion	11.258	-	-	-	-	-	-	-	-	-	11.258	-	-	-	-	-
1.2. Production of derived energy bearers	1 218.155	-	-	6.286	-	-	207.988	39.850	279.351	99.498	16.312	-	43.598	-	511.589	13.682
9. Consumption by energy sector	256.414	-	-	-	-	-	0.035	-	7.514	-	0.002	200.744	26.935	-	21.148	0.036
9.1.1 Crude petroleum and natural gas production	186.120	-	-	-	-	-	-	-	6.867	-	-	167.530	-	-	11.723	-
9.1.2 Natural gas which is flared off on oil fields	33.214	-	-	-	-	-	-	-	-	-	-	33.214	-	-	-	-
9.2. Coal mines	0.278	-	-	-	-	-	-	-	0.143	-	-	-	-	-	0.135	-
9.3. Petroleum refineries	28.984	-	-	-	-	-	0.000	-	0.153	-	-	-	26.935	-	1.895	-
9.4. Pumping storage power plants	4.817	-	-	-	-	-	-	-	-	-	-	-	-	-	4.817	-
9.5. Hydro electric power plants	2.263	-	-	-	-	-	0.030	-	0.047	-	-	-	-	-	2.186	-
9.6. Thermal power plants	0.286	-	-	-	-	-	-	-	0.270	-	-	-	-	-	0.017	-
9.7. Combined heat and power plants	0.124	-	-	-	-	-	0.000	-	0.033	-	-	-	-	-	0.090	-
9.8. District heating plants	0.329	-	-	-	-	-	0.005	-	0.001	-	0.002	-	-	-	0.285	0.036
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	40.877	-	-	-	-	-	-	-	-	-	-	0.454	2.967	-	34.837	2.618
11. Statistical differences (7-8+1.2-9-10-13.1)	81.741	3.605	0.220	2.901	0.000	80.038	23.913	3.312	10.022	-25.316	-16.419	-0.535	-	-	-0.000	0.001
13.1 Net domestic consumption including non-energy use	867.703	19.005	10.536	20.285	47.710	-	59.402	18.157	165.388	14.373	49.826	35.675	13.047	-	403.277	11.021
13. Net domestic consumption	780.660	16.551	10.536	0.391	47.710	-	59.402	18.155	164.895	13.454	9.791	12.430	13.047	-	403.277	11.021
14. Manufacturing, mining and quarrying	272.606	16.541	10.480	0.391	18.010	-	-	0.072	10.519	8.038	7.675	8.772	12.345	-	178.620	1.144
14.1. Mining and quarrying	4.960	-	-	-	0.001	-	-	0.025	2.723	0.057	0.041	0.194	0.127	-	1.787	0.005
14.2. Manufacture of paper and paper products	36.931	-	-	-	12.773	-	-	-	0.146	4.034	0.108	0.122	0.141	-	19.607	-
14.3. Manufacture of industrial chemicals	55.653	5.799	2.633	-	0.359	-	-	0.000	0.380	1.192	2.554	3.502	11.627	-	27.071	0.536
14.4. Manufacture of iron, steel and ferro alloys	33.632	7.392	7.299	-	-	-	-	-	0.477	-	0.051	0.073	0.312	-	18.022	0.005
14.5. Manufacture of aluminium and other non-ferrous metals	86.123	-	-	-	-	-	-	-	0.469	-	1.031	2.014	-	-	82.553	0.055
14.6. Other manufacturing industries	55.308	3.350	0.549	0.391	4.878	-	-	0.047	6.325	2.754	3.890	2.865	0.138	-	29.580	0.544
15. Transport	197.847	-	-	-	3.155	-	58.439	14.120	112.911	4.680	0.081	2.006	-	-	2.455	-
15.1. Railways and subways	3.082	-	-	-	0.022	-	-	-	0.605	-	-	-	-	-	2.455	-
15.2. Air transport	14.198	-	-	-	-	-	0.078	14.120	-	-	-	-	-	-	-	-
15.3. Road transport	146.091	-	-	-	3.133	-	56.638	-	86.102	-	0.081	0.137	-	-	-	-
15.4. Coastal shipping	34.476	-	-	-	-	-	1.723	-	26.204	4.680	-	1.869	-	-	-	-
16. Other sectors	310.206	0.010	0.056	-	26.545	-	0.964	3.963	41.465	0.737	2.036	1.652	0.702	-	222.202	9.876
16.1. Fishing	17.189	-	-	-	-	-	0.207	0.003	16.158	0.137	-	0.045	-	-	0.641	-
16.2. Agriculture	13.995	-	-	-	0.049	-	0.009	0.014	5.922	0.045	0.269	0.629	-	-	7.049	0.011
16.3. Households	161.285	0.006	0.010	-	25.921	-	0.721	2.423	3.286	0.049	0.554	0.129	-	-	125.600	2.586
16.4. Other consumers	107.313	0.004	0.046	-	0.331	-	0.011	1.515	10.535	0.503	0.382	0.828	0.702	-	85.175	7.280
16.5 Construction	10.424	-	-	-	0.244	-	0.016	0.009	5.564	0.003	0.830	0.020	-	-	3.737	-
12. Consumption for non-energy purposes	87.043	2.454	-	19.894	-	-	-	0.002	0.493	0.918	40.035	23.246	-	-	-	-
12.1 Manufacture of industrial chemicals	62.981	-	-	1.234	-	-	-	-	0.245	-	38.255	23.246	-	-	-	-
12.2 Other manufacturing	24.063	2.454	-	18.660	-	-	-	0.002	0.248	0.918	1.780	-	-	-	-	-

Annex III

Energy balance	**2009**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and w ind pow er	Electricity	District heating
1.1.1 Production of primary energy bearers	9 040.315	74.199	-	-	53.713	4 146.541	237.543	-	-	-	274.082	3 796.844	-	457.394	-	-
1.1.2 Production of natural gas that is flared off	17.977	-	-	-	-	-	-	-	-	-	-	17.977	-	-	-	-
2. Imports	280.078	11.834	7.937	13.295	4.775	51.839	16.546	8.646	73.583	59.287	11.995	-	-	-	20.340	-
3. Exports	8 187.109	67.345	-	0.054	0.070	3 645.005	366.744	5.998	97.921	84.548	269.180	3 597.566	-	-	52.677	-
4.1 Bunkering	23.298	-	-	-	-	-	-	-	14.353	8.944	-	-	-	-	-	-
4.2 Foreign aviation	14.962	-	-	-	-	-	-	14.962	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	23.946	-3.645	0.435	0.337	-	22.798	-0.317	0.380	2.166	-1.300	3.092	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 136.947	15.042	8.372	13.579	58.418	576.173	-112.972	-11.935	-36.525	-35.505	19.989	217.254	-	457.394	-32.337	-
8. Energy converted	1 175.651	0.735	1.502	-	11.980	547.704	46.483	1.084	14.971	54.819	11.569	23.715	0.551	457.394	3.124	0.019
8.1. In blast furnaces	1.502	-	1.502	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	665.012	-	-	-	-	547.704	46.483	1.084	13.734	54.819	1.188	-	-	-	-	-
8.3. In thermal pow er plants	24.664	-	-	-	0.863	-	-	-	0.135	-	-	23.148	0.518	-	-	-
8.4. In dual purpose pow er plants	5.659	0.735	-	-	4.757	-	-	-	0.099	-	-	-	-	-	0.068	-
8.5. In district heating plants	11.376	-	-	-	6.360	-	-	-	1.003	-	0.336	0.568	0.033	-	3.057	0.019
8.6. In hydropow er plants	457.394	-	-	-	-	-	-	-	-	-	-	-	-	457.394	-	-
8.7. Other conversion	10.045	-	-	-	-	-	-	-	-	-	10.045	-	-	-	-	-
1.2. Production of derived energy bearers	1 188.682	-	-	5.296	-	-	232.309	34.522	278.898	85.222	19.829	-	42.526	-	474.383	15.698
9. Consumption by energy sector	240.146	-	-	-	-	-	0.024	0.008	8.790	-	0.145	177.709	27.951	-	25.494	0.026
9.1.1 Crude petroleum and natural gas production	184.828	-	-	-	-	-	-	-	8.311	-	-	159.733	-	-	16.784	-
9.1.2 Natural gas w hich is flared off on oil fields	17.977	-	-	-	-	-	-	-	-	-	-	17.977	-	-	-	-
9.2. Coal mines	0.141	-	-	-	-	-	-	-	0.006	-	-	-	-	-	0.135	-
9.3. Petroleum refineries	30.251	-	-	-	-	-	0.000	-	0.091	-	0.145	-	27.951	-	2.064	-
9.4. Pumping storage pow er plants	4.086	-	-	-	-	-	-	-	-	-	-	-	-	-	4.086	-
9.5. Hydro electric pow er plants	2.314	-	-	-	-	-	0.018	0.008	0.048	-	-	-	-	-	2.241	-
9.6. Thermal pow er plants	0.394	-	-	-	-	-	-	-	0.311	-	-	-	-	-	0.083	-
9.7. Combined heat and pow er plants	0.071	-	-	-	-	-	-	-	0.022	-	-	-	-	-	0.049	-
9.8. District heating plants	0.083	-	-	-	-	-	0.005	-	0.001	-	-	-	-	-	0.052	0.026
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	37.704	-	-	-	-	-	-	-	-	-	-	0.698	2.722	-	31.064	3.219
11. Statistical differences (7-8+1.2-9-10-13.1)	47.069	0.310	-0.006	2.984	-	28.469	17.070	3.174	49.179	-17.811	-19.625	-16.673	-0.000	-	0.000	0.000
13.1 Net domestic consumption including non-energy use	825.060	13.997	6.876	15.891	46.437	-	55.761	18.322	169.434	12.709	47.729	31.804	11.302	-	382.363	12.435
13. Net domestic consumption	749.080	12.307	6.876	0.336	46.437	-	55.761	18.319	168.941	11.791	8.998	13.214	11.302	-	382.363	12.435
14. Manufacturing, mining and quarrying	223.909	12.297	6.866	0.294	15.137	-	-	0.046	8.839	7.311	6.939	9.240	10.890	-	144.770	1.279
14.1. Mining and quarrying	3.718	-	-	-	0.001	-	-	0.020	1.863	0.031	0.044	0.152	0.031	-	1.570	0.007
14.2. Manufacture of paper and paper products	30.620	-	-	-	9.676	-	-	0.001	0.386	3.651	0.128	0.035	0.124	-	16.619	-
14.3. Manufacture of industrial chemicals	48.120	3.798	1.455	-	0.390	-	-	0.000	0.627	1.234	2.995	4.498	10.330	-	22.322	0.470
14.4. Manufacture of iron, steel and ferro alloys	23.488	5.061	4.949	-	0.026	-	-	0.000	0.471	-	0.044	0.052	0.238	-	12.640	0.007
14.5. Manufacture of aluminium and other non-ferrous metals	71.883	-	-	0.089	-	-	-	0.000	0.317	-	0.876	1.865	-	-	68.709	0.026
14.6. Other manufacturing industries	46.079	3.438	0.463	0.205	5.045	-	-	0.025	5.175	2.395	2.852	2.638	0.167	-	22.909	0.768
15. Transport	197.029	-	-	-	3.724	-	54.773	14.572	115.506	3.869	0.081	2.137	-	-	2.367	-
15.1. Railw ays and subw ays	2.989	-	-	-	0.025	-	-	-	0.597	-	-	-	-	-	2.367	-
15.2. Air transport	14.651	-	-	-	-	-	0.079	14.572	-	-	-	-	-	-	-	-
15.3. Road transport	144.203	-	-	-	3.699	-	52.971	-	87.309	-	0.081	0.145	-	-	-	-
15.4. Coastal shipping	35.185	-	-	-	-	-	1.723	-	27.600	3.869	-	1.992	-	-	-	-
16. Other sectors	328.143	0.010	0.010	0.042	27.576	-	0.988	3.702	44.596	0.610	1.978	1.837	0.412	-	235.227	11.156
16.1. Fishing	19.633	-	-	-	-	-	0.217	0.012	18.574	0.106	-	-	-	-	0.724	-
16.2. Agriculture	13.853	-	-	-	0.150	-	0.007	0.014	5.746	-	0.276	0.687	-	-	6.955	0.018
16.3. Households	167.237	0.006	0.010	-	26.638	-	0.721	2.158	3.581	0.006	0.544	0.145	-	-	130.727	2.702
16.4. Other consumers	116.993	0.004	-	0.042	0.542	-	0.027	1.512	11.227	0.498	0.370	0.966	0.412	-	92.958	8.436
16.5 Construction	10.426	-	-	-	0.246	-	0.015	0.006	5.469	-	0.789	0.038	-	-	3.863	-
12. Consumption for non-energy purposes	75.979	1.690	-	15.555	-	-	-	0.002	0.493	0.918	38.731	18.590	-	-	-	-
12.1 Manufacture of industrial chemicals	56.564	-	-	0.777	-	-	-	-	0.245	-	36.952	18.590	-	-	-	-
12.2 Other manufacturing	19.415	1.690	-	14.777	-	-	-	0.002	0.248	0.918	1.780	-	-	-	-	-

Annex III

Energy balance	**2010**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	8 720.823	54.372	-	-	62.844	3 744.286	225.847	-	-	-	264.322	3 944.241	-	424.912	-	-
1.1.2 Production of natural gas that is flared off	17.326	-	-	-	-	-	-	-	-	-	-	17.326	-	-	-	-
2. Imports	320.614	19.210	12.366	14.436	6.549	42.215	17.083	17.473	51.206	71.933	15.323	-	-	-	52.821	-
3. Exports	7 759.761	47.525	0.100	0.686	0.280	3 288.836	316.204	7.580	90.057	72.993	244.485	3 665.371	-	-	25.644	-
4.1 Bunkering	19.414	-	-	-	-	-	-	-	11.747	7.667	-	-	-	-	-	-
4.2 Foreign aviation	18.041	-	-	-	-	-	-	18.041	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	9.432	-6.226	-0.131	0.140	-	2.133	8.446	-0.048	7.001	0.789	-2.670	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 270.979	19.830	12.135	13.890	69.113	499.797	-64.828	-8.196	-43.597	-7.939	32.490	296.196	-	424.912	27.177	-
8. Energy converted	1 126.354	0.736	2.631	-	15.410	504.527	46.852	3.865	15.383	62.290	12.668	33.052	0.965	424.912	3.045	0.020
8.1. In blast furnaces	2.631	-	2.631	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	631.008	-	-	-	-	504.527	46.852	3.865	12.435	62.290	1.038	-	-	-	-	-
8.3. In thermal power plants	34.247	-	-	-	1.271	-	-	-	0.138	-	-	32.374	0.464	-	-	-
8.4. In dual purpose power plants	7.625	0.736	-	-	6.330	-	-	-	0.089	-	-	-	0.419	-	0.052	-
8.5. In district heating plants	14.842	-	-	-	7.808	-	-	-	2.721	-	0.540	0.678	0.082	-	2.993	0.020
8.6. In hydropower plants	424.912	-	-	-	-	-	-	-	-	-	-	-	-	424.912	-	-
8.7. Other conversion	11.089	-	-	-	-	-	-	-	-	-	11.089	-	-	-	-	-
1.2. Production of derived energy bearers	1 130.859	-	-	5.687	-	-	220.462	32.307	264.201	79.465	19.242	-	44.377	-	445.068	20.049
9. Consumption by energy sector	233.240	-	-	-	-	-	0.017	-	9.226	0.052	0.231	170.607	26.210	-	26.614	0.282
9.1.1 Crude petroleum and natural gas production	181.286	-	-	-	-	-	-	-	8.762	-	-	153.068	-	-	19.456	-
9.1.2 Natural gas which is flared off on oil fields	17.326	-	-	-	-	-	-	-	-	-	-	17.326	-	-	-	-
9.2. Coal mines	0.137	-	-	-	-	-	-	-	0.015	-	-	-	-	-	0.122	-
9.3. Petroleum refineries	29.726	-	-	-	-	-	0.001	-	0.080	0.052	0.231	-	26.210	-	2.903	0.248
9.4. Pumping storage power plants	2.066	-	-	-	-	-	-	-	-	-	-	-	-	-	2.066	-
9.5. Hydro electric power plants	1.960	-	-	-	-	-	0.017	-	0.055	-	-	-	-	-	1.889	-
9.6. Thermal power plants	0.337	-	-	-	-	-	-	-	0.250	-	-	-	-	-	0.088	-
9.7. Combined heat and power plants	0.060	-	-	-	-	-	-	-	0.020	-	-	-	-	-	0.040	-
9.8. District heating plants	0.128	-	-	-	-	-	-	-	0.045	-	-	-	-	-	0.050	0.033
9.9. Gas supply	0.213	-	-	-	-	-	-	-	-	-	-	0.213	-	-	-	-
10. Losses in transport and distribution	42.583	-	-	-	-	-	-	-	-	-	-	0.554	4.197	-	34.164	3.668
11. Statistical differences (7-8+1.2-9-10-13.1)	116.100	0.709	1.053	2.859	-	-4.729	56.249	1.359	11.269	-1.268	-10.289	58.889	0.000	-	-0.000	0.000
13.1 Net domestic consumption including non-energy use	883.562	18.385	8.451	16.719	53.704	-	52.516	18.886	184.726	10.451	49.122	33.094	13.005	-	408.422	16.080
13. Net domestic consumption	806.278	16.191	8.451	0.691	53.704	-	52.516	18.886	184.726	10.451	9.501	13.653	13.005	-	408.422	16.080
14. Manufacturing, mining and quarrying	249.241	16.181	8.441	0.625	18.016	-	-	0.030	11.330	7.807	7.369	9.210	12.489	-	156.148	1.594
14.1. Mining and quarrying	4.756	-	-	-	0.001	-	-	0.016	2.422	0.027	0.053	0.175	0.044	-	2.012	0.006
14.2. Manufacture of paper and paper products	33.880	-	-	-	11.704	-	-	-	0.151	4.211	0.148	0.028	0.091	-	17.545	0.002
14.3. Manufacture of industrial chemicals	56.509	5.867	2.297	0.033	0.880	-	-	0.000	1.462	0.932	2.519	3.642	11.471	-	26.859	0.548
14.4. Manufacture of iron, steel and ferro alloys	30.310	7.019	5.696	0.062	0.082	-	-	0.001	0.303	-	0.047	0.050	0.696	-	16.345	0.007
14.5. Manufacture of aluminium and other non-ferrous metals	72.087	-	-	0.095	0.006	-	-	0.000	0.478	0.003	1.175	3.128	-	-	67.164	0.038
14.6. Other manufacturing industries	51.700	3.295	0.449	0.434	5.344	-	-	0.013	6.514	2.634	3.428	2.186	0.186	-	26.224	0.993
15. Transport	203.978	-	-	-	4.552	-	51.524	14.572	125.959	2.458	0.081	2.357	0.003	-	2.472	-
15.1. Railways and subways	3.026	-	-	-	0.024	-	-	-	0.530	-	-	-	-	-	2.472	-
15.2. Air transport	14.653	-	-	-	-	-	0.081	14.572	-	-	-	-	-	-	-	-
15.3. Road transport	149.994	-	-	-	4.003	-	49.720	-	96.001	-	0.081	0.186	0.003	-	-	-
15.4. Coastal shipping	36.305	-	-	-	0.526	-	1.723	-	29.428	2.458	-	2.171	-	-	-	-
16. Other sectors	353.060	0.010	0.010	0.067	31.135	-	0.992	4.285	47.436	0.186	2.052	2.086	0.513	-	249.802	14.486
16.1. Fishing	20.391	-	-	-	-	-	0.222	0.009	19.348	0.088	-	-	-	-	0.724	-
16.2. Agriculture	14.316	-	-	-	0.185	-	0.009	0.019	5.754	-	0.301	0.816	-	-	7.225	0.009
16.3. Households	185.284	0.006	0.010	-	29.798	-	0.721	2.657	4.338	0.006	0.566	0.166	-	-	143.114	3.902
16.4. Other consumers	122.310	0.004	-	0.067	0.899	-	0.025	1.593	12.543	0.089	0.388	1.083	0.513	-	94.530	10.576
16.5 Construction	10.759	-	-	-	0.253	-	0.015	0.008	5.453	0.003	0.796	0.021	-	-	4.208	-
12. Consumption for non-energy purposes	77.283	2.194	-	16.028	-	-	-	-	0.000	-	39.621	19.441	-	-	-	-
12.1 Manufacture of industrial chemicals	60.168	-	-	1.167	-	-	-	-	-	-	39.560	19.441	-	-	-	-
12.2 Other manufacturing	17.115	2.194	-	14.861	-	-	-	-	0.000	-	0.060	-	-	-	-	-

Annex III

Energy balance	**2011**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, garbage	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Natural gas	Other gases	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	8 328.490	38.956	-	-	66.182	3 490.867	238.664	-	-	-	282.606	3 767.075	-	444.141	-	-
1.1.2 Production of natural gas that is flared off	17.060	-	-	-	-	-	-	-	-	-	-	17.060	-	-	-	-
2. Imports	295.194	19.969	12.965	12.924	6.807	48.201	15.781	19.043	52.202	55.714	11.024	0.049	-	-	40.517	-
3. Exports	7 412.507	42.258	-	1.056	3.647	2 907.290	373.903	10.003	129.034	76.097	259.232	3 558.403	-	-	51.584	-
4.1 Bunkering	19.567	-	-	-	-	-	-	-	11.657	7.909	-	-	-	-	-	-
4.2 Foreign aviation	17.814	-	-	-	-	-	-	17.814	-	-	-	-	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	-20.817	5.241	0.547	-1.803	-	-19.032	1.433	-0.093	-10.266	2.495	0.661	-	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1 170.039	21.908	13.512	10.064	69.341	612.746	-118.024	-8.868	-98.756	-25.798	35.058	225.780	-	444.141	-11.067	-
8. Energy converted	1 213.363	0.707	2.705	-	17.614	563.266	50.204	8.745	28.616	52.483	12.284	26.569	3.471	444.141	2.520	0.036
8.1. In blast furnaces	2.705	-	2.705	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	702.548	-	-	-	-	563.266	50.204	8.745	26.952	52.482	0.899	-	-	-	-	-
8.3. In thermal power plants	27.829	-	-	-	1.286	-	-	-	0.136	-	-	25.909	0.498	-	-	-
8.4. In dual purpose power plants	12.410	0.707	-	-	8.632	-	-	-	0.139	0.001	-	-	2.882	-	0.049	-
8.5. In district heating plants	12.625	-	-	-	7.695	-	-	-	1.390	0.000	0.282	0.660	0.091	-	2.471	0.036
8.6. In hydropower plants	444.141	-	-	-	-	-	-	-	-	-	-	-	-	444.141	-	-
8.7. Other conversion	11.103	-	-	-	-	-	-	-	-	-	11.103	-	-	-	-	-
1.2. Production of derived energy bearers	1 218.351	-	-	7.480	-	-	239.442	36.519	313.287	74.905	19.845	-	43.546	-	461.320	22.006
9. Consumption by energy sector	233.035	-	-	-	-	-	0.017	-	9.952	-	0.136	164.812	23.691	-	31.243	3.183
9.1.1 Crude petroleum and natural gas production	176.736	-	-	-	-	-	-	-	9.520	-	-	147.751	-	-	19.465	-
9.1.2 Natural gas which is flared off on oil fields	17.060	-	-	-	-	-	-	-	-	-	-	17.060	-	-	-	-
9.2. Coal mines	0.150	-	-	-	-	-	-	-	0.022	-	-	-	-	-	0.128	-
9.3. Petroleum refineries	29.902	-	-	-	-	-	0.001	-	0.068	-	0.136	-	23.691	-	2.862	3.145
9.4. Pumping storage power plants	6.489	-	-	-	-	-	-	-	-	-	-	-	-	-	6.489	-
9.5. Hydro electric power plants	2.062	-	-	-	-	-	0.017	-	0.055	-	-	-	-	-	1.990	-
9.6. Thermal power plants	0.336	-	-	-	-	-	-	-	0.259	-	-	-	-	-	0.077	-
9.7. Combined heat and power plants	0.150	-	-	-	-	-	-	-	0.028	-	-	-	-	-	0.122	-
9.8. District heating plants	0.149	-	-	-	-	-	-	-	0.002	-	0.001	-	-	-	0.109	0.038
9.9. Gas supply	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Losses in transport and distribution	45.564	-	-	-	-	-	-	-	-	-	-	0.526	3.248	-	37.052	4.738
11. Statistical differences (7-8+1.2-9-10-13.1)	50.167	1.865	2.306	0.465	-	49.480	23.220	0.903	-8.536	-12.224	-5.563	-1.748	-0.001	-	-0.000	-0.000
13.1 Net domestic consumption including non-energy use	846.262	19.336	8.501	17.079	51.728	-	47.977	18.004	184.499	8.847	48.046	35.622	13.136	-	379.438	14.049
13. Net domestic consumption	767.754	17.149	8.501	0.592	51.728	-	47.977	18.004	184.499	8.847	9.280	14.554	13.136	-	379.438	14.049
14. Manufacturing, mining and quarrying	248.657	17.139	8.402	0.592	19.699	-	-	0.025	10.734	6.537	7.227	10.047	12.652	-	154.191	1.413
14.1. Mining and quarrying	5.329	-	-	-	0.002	-	-	0.015	2.872	0.000	0.097	0.179	0.004	-	2.155	0.004
14.2. Manufacture of paper and paper products	32.525	-	-	-	13.340	-	-	-	0.125	3.039	0.107	0.089	0.122	-	15.702	0.001
14.3. Manufacture of industrial chemicals	56.604	6.287	2.036	0.068	0.768	-	-	0.000	1.622	0.872	2.780	3.658	11.668	-	26.366	0.478
14.4. Manufacture of iron, steel and ferro alloys	32.992	7.640	5.949	0.120	0.114	-	-	-	0.342	-	0.066	0.043	0.656	-	18.058	0.005
14.5. Manufacture of aluminium and other non-ferrous metals	71.816	-	-	0.051	0.013	-	-	0.000	0.328	-	0.839	3.015	-	-	67.539	0.030
14.6. Other manufacturing industries	49.391	3.212	0.417	0.353	5.463	-	-	0.009	5.444	2.625	3.338	3.063	0.202	-	24.371	0.894
15. Transport	203.061	-	-	-	4.516	-	46.984	14.572	129.566	2.179	0.081	2.689	0.012	-	2.463	-
15.1. Railways and subways	2.991	-	-	-	0.021	-	-	-	0.506	-	-	-	-	-	2.463	-
15.2. Air transport	14.649	-	-	-	-	-	0.077	14.572	-	-	-	-	-	-	-	-
15.3. Road transport	148.297	-	-	-	4.494	-	45.183	-	98.312	-	0.081	0.213	0.012	-	-	-
15.4. Coastal shipping	37.125	-	-	-	-	-	1.723	-	30.747	2.179	-	2.475	-	-	-	-
16. Other sectors	316.037	0.010	0.099	-	27.513	-	0.994	3.407	44.199	0.131	1.973	1.818	0.472	-	222.784	12.637
16.1. Fishing	20.620	-	-	-	-	-	0.222	0.009	19.624	0.042	-	-	-	-	0.724	-
16.2. Agriculture	13.441	-	-	-	0.175	-	0.009	0.012	5.552	-	0.224	0.606	-	-	6.848	0.014
16.3. Households	163.202	0.006	0.010	-	26.297	-	0.721	1.929	3.126	-	0.566	0.138	-	-	127.572	2.836
16.4. Other consumers	107.653	0.004	0.089	-	0.784	-	0.025	1.453	10.266	0.089	0.357	1.046	0.472	-	83.279	9.787
16.5 Construction	11.121	-	-	-	0.256	-	0.016	0.004	5.630	-	0.825	0.027	-	-	4.362	-
12. Consumption for non-energy purposes	78.508	2.187	-	16.487	-	-	-	-	0.000	-	38.766	21.068	-	-	-	-
12.1 Manufacture of industrial chemicals	60.847	-	-	1.074	-	-	-	-	-	-	38.705	21.068	-	-	-	-
12.2 Other manufacturing	17.661	2.187	-	15.413	-	-	-	-	0.000	-	0.060	-	-	-	-	-

Annex IV: CO_2 capture and storage at petroleum production fields – storage site characteristics and monitoring methodology

1 Capture from Sleipner Vest Field well stream and storage at Sleipner Øst Field

1.1 The reservoir's ability to store CO_2 over time

Key goals for geological CO_2 storage site selection and characterization are to; assess how much CO_2 can be stored at a potential storage site, demonstrate that the site is capable of meeting required storage performance criteria; and establish a baseline for the management and monitoring of the CO_2 injection and storage.

Excess CO_2 from the Sleipner Vest Field is injected into the Utsira Formation at Sleipner Øst for storage. The Utsira Formation aquifer, which is located above the producing reservoirs at a depth of 800 – 1000 m below sea level, was chosen for CO_2 storage because of its large extension (which guarantees sufficient volume), and its excellent porosity and permeability (which is well suited for high injectivity). Furthermore, the formation is overlain by a thick, widespread sequence of Hordaland Group shales, which should act as an effective barrier to vertical CO_2 leakage, see figure below:

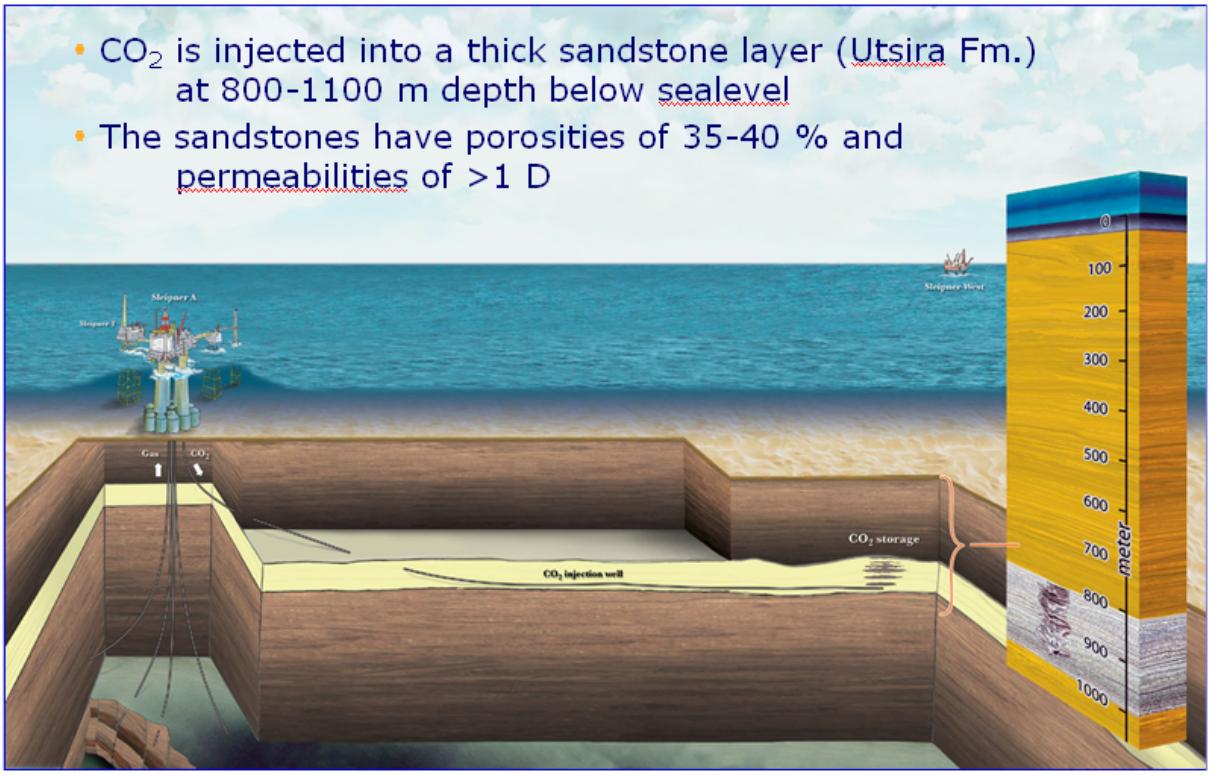


Figure 1. CO_2 capture at Sleipner Vest and storage at Sleipner Øst.

The Utsira formation has the following properties:

- Dome type of structure
- Large extension

- Thickness: 150 – 200 m
- Temp. = 37 degC, P = 104 bar (hydrostatic)
- Unconsolidated fine-grained sand
- High permeability (~ 2 D) and high porosity (35-40%)
- Homogeneous
- Water filled

It also contains several thin intercalated shale layers (1-1.5m), as well as a 5 m thick shaly interval about 20 m below the top. In the Sleipner case it has been very important to locate the injection well and the storage site such that the injected CO_2 could not migrate back to the Sleipner A platform (SLA) and the production wells. This will both prevent corrosion problems in the production wells and minimise the risk of CO_2 leakage through production wells. The injection point is located 2.5 km east of the Sleipner A platform. Following is a figure illustrating the distance between the injection point and the Sleipner installation. Migration evaluations have been based on the Top Utsira map (figure below) with the CO_2 expected to migrate vertically to the sealing shales and horizontally along the saddle point of the structure. This will take the CO_2 away from other wells drilled from the Sleipner platform.

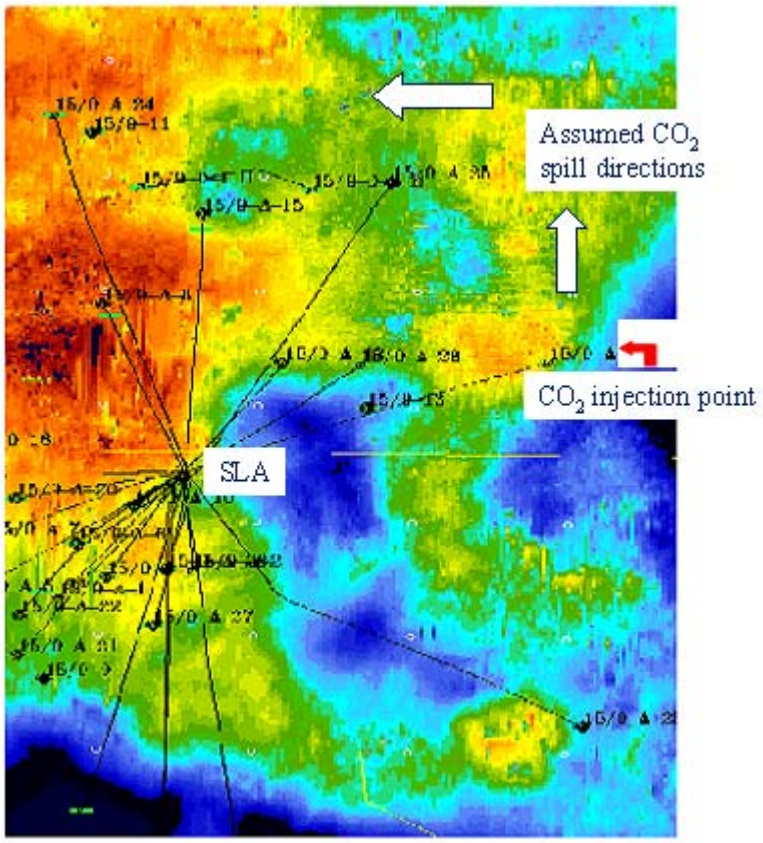


Figure 2. Position of CO_2 injection point and expected migration direction of CO_2 Sleipner field.

1.2 Applied methods for monitoring the injected CO_2

a) 4D seismic monitoring:

- Baseline seismic survey was shot prior to injection in 1994.

- Repeat time lapse seismic monitoring have been acquired in 1999, 2001, 2002, 2004, 2006, 2008 and 2010

b) Gravimetric monitoring:

- Pre-installed 30 concrete benchmarks in 2002 across the CO_2 bubble
- Repeat survey 2005.

c) Pressure measurements:

The need for reservoir measurements of pressure and temperature in the injection well is being continuously evaluated. Up until now, these measurements have not been deemed critical, but plans are in place to have these measurements taken later in 2006.

d) Well monitoring, safety precautions (leakage):

The wells in the Sleipner area are plotted on a chart to indicate the positioning relative to the CO_2 injection well. The relative distances are given at the top of the Utsira formation. . The labels numbered "900" indicate where the wells are penetrating the 900 meter depth level (top of Utsira formation).

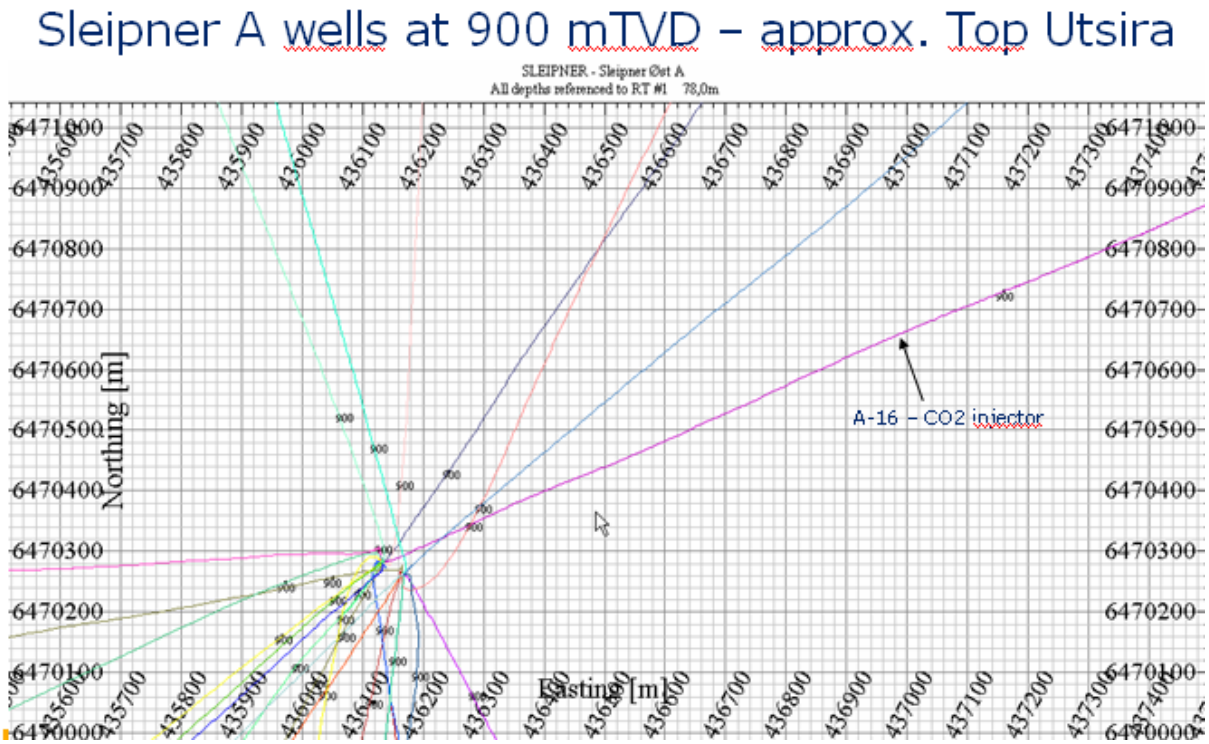


Figure 3. Positions of Sleipner production wells relative to the CO_2 injection well.

The figure shows that the distance from the CO_2 injection well to the closest neighbouring well is 1000 metres at top of the Utsira formation. Note that the extension of the CO_2 plume is found to be extending NE-SW from the injection point, based on seismic data, and that no production wells (other than the injector) are exposed to the CO_2 plume. This is in accordance with the simulations carried out for the injection on Sleipner.

The main well design at Utsira level:

- 18 5/8" casing set above Utsira Formation
- 13 3/8" casing through Utsira Formation
  - 13 Cr casing from 10 m MD below to 50 m MD above Utsira Formation
  - cemented into 18 5/8" casing

The material quality chosen for the casing through Utsira formation, increases the wells' resistance against CO_2 corrosion.

The reported amounts of CO_2 which are injected in the Utsira formation are based on continuous metering of the gas stream by orifice meter.

1.3 Results of the monitoring programme

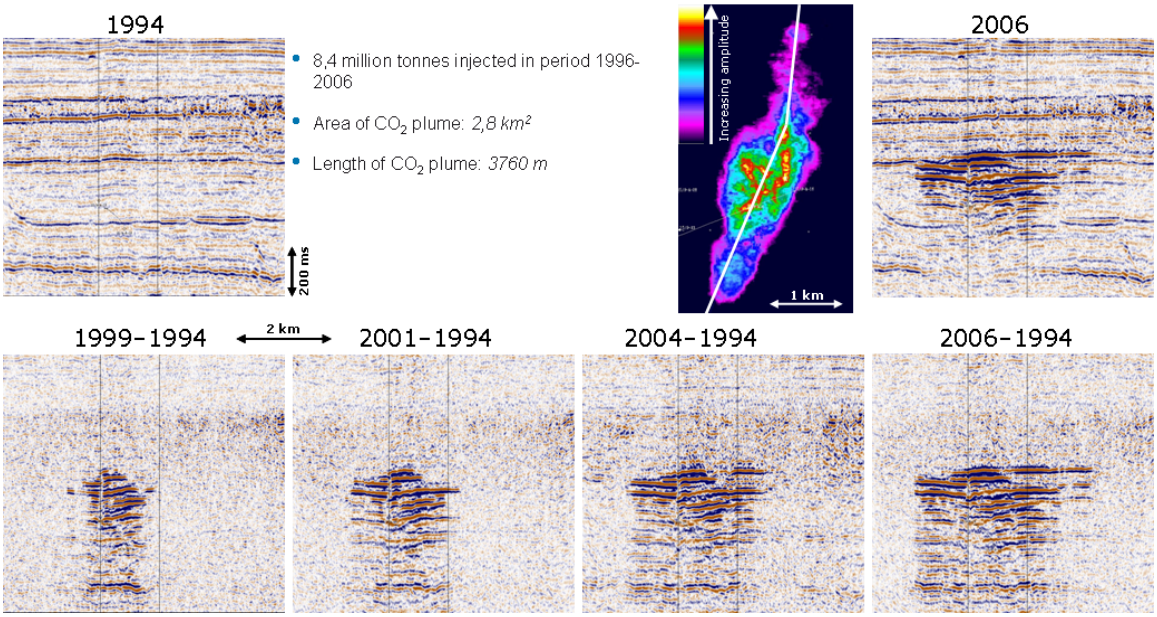
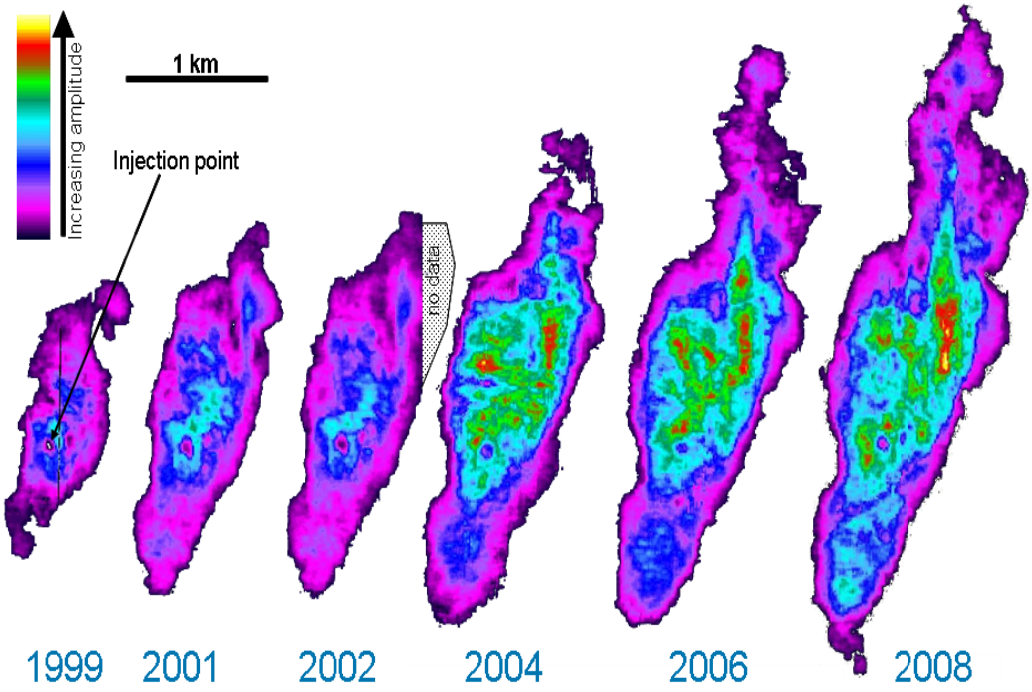


Figure 4. Results of seismic monitoring 1994 – 2006.

The figure above is based on seismic data from 1994 – 2006.

Based on the seismic data, the extent of the CO_2 plume has been estimated. The figure below shows the CO_2 plume extension in the years 1999, 2001, 2002, 2004, 2006 and 2008.



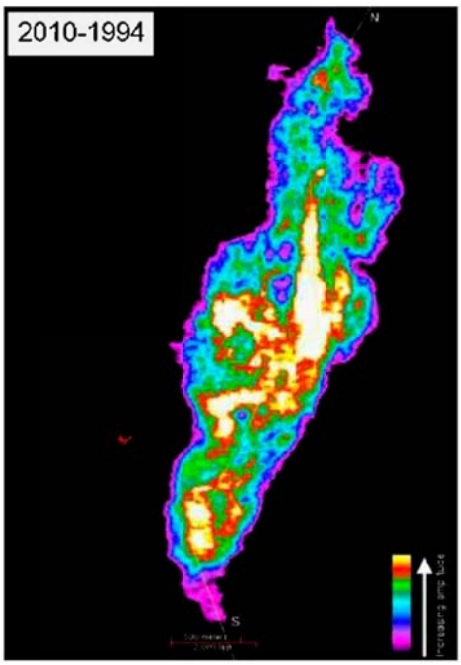


Figure 5. CO_2 plume extension in 1999 to 2008 and the last figure showing cumulative amplitude from 4D seismic. The differences in amplitudes reflect the cumulative thickness of the CO_2 layers.

The label "No data" in the above figure marks the eastern edge of the mapped area.

In 2010, , after injection of about 12 million tonnes during the last 12 years, the maximum lateral migration from the injection point was 2.9 km to the northeast, and the area of the CO_2 plume was about 3.6 km^2. Since the injection started, the plume has steadily grown, and has adopted a preferred NE-SW elongation, which is believed to be caused by the topography of the aquifer/cap rock interface and the inherent buoyancy of the injected CO_2 within the saline aquifer.

b) Gravimetric monitoring:

There is a large uncertainty on in-situ CO_2 density, related to temperature, which cannot be resolved by seismic measurements. CO_2 is close to critical point, and possible densities range from 0.2 to more than 0.7. The gravity data supports a low-density/high temperature CO_2 plume.

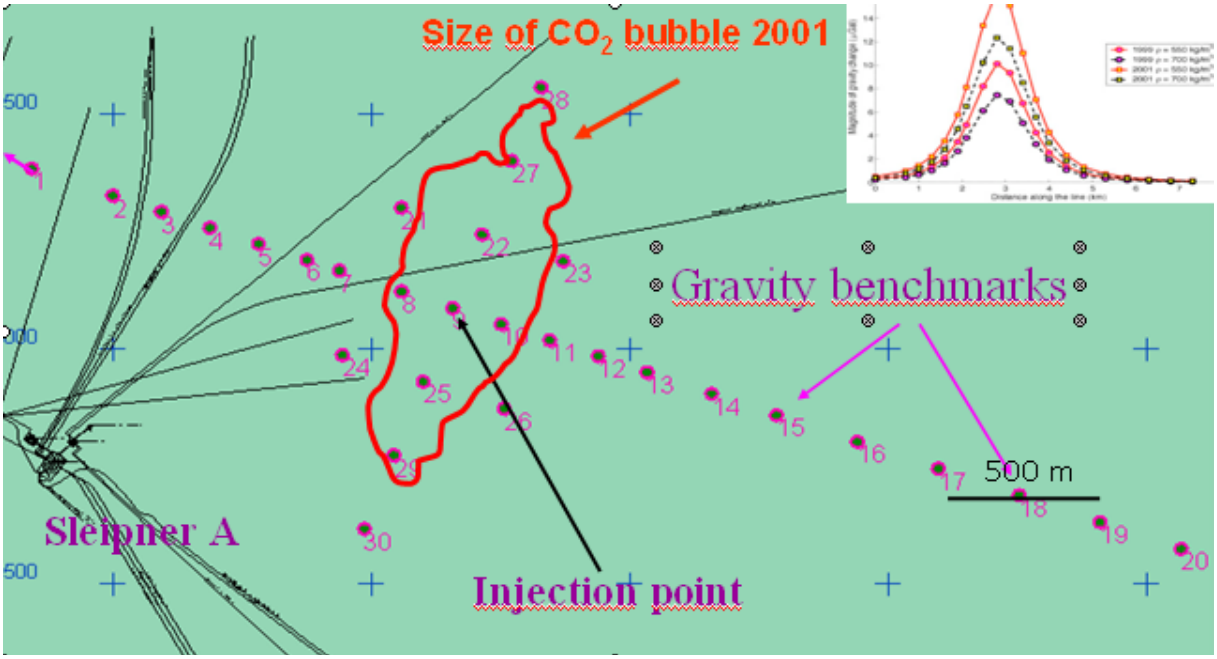


Figure 6. Gravimetric monitoring.

c) Reservoir simulation:

Flow simulation models, which match the 4D seismic data reasonably well, have been used to predict the CO_2 behaviour. The figure below illustrates results from the simulation model.

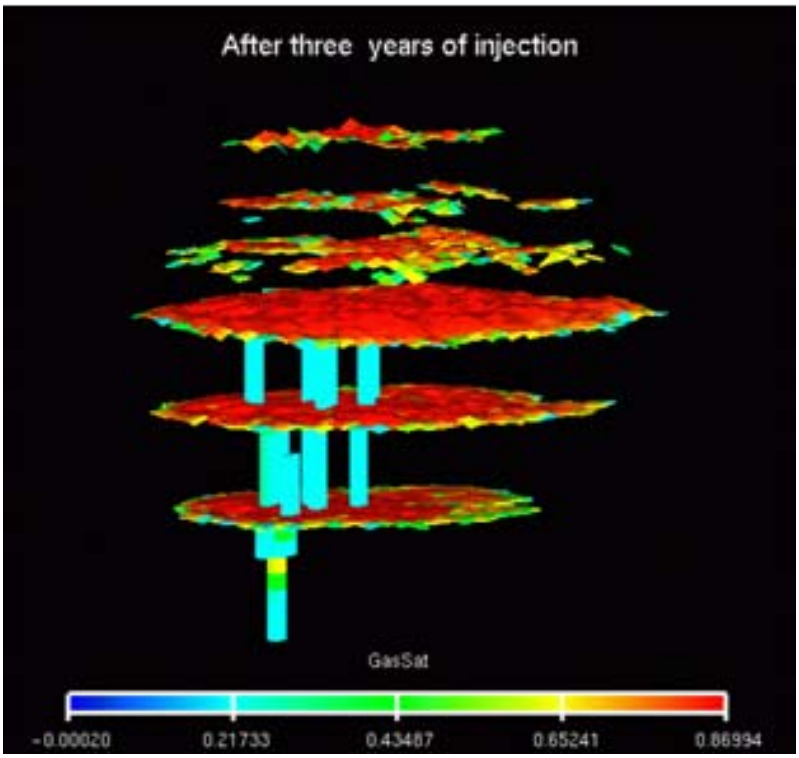


Figure 7. Flow simulation of CO_2.

The results from the simulations indicate that cap rock shales provide a capillary seal for the CO_2 phase.

Dissolution of CO_2 from the gas cap into the underlying brine column will have a most pronounced effect. The brine on top of the column, which becomes enriched in CO_2, is denser than the brine below due to the special volumetric properties of the CO_2 – brine system. This instability could induce convection currents and enhance the dissolution of CO_2.

The following figure shows simulation results (seen from above) without taking into account the effect of CO_2 dissolution. This gives a conservative estimate of the extent of the CO_2 plume, as dissolution of the CO_2 will contribute to the CO_2 "sinking" inside the Utsira formation, thus reducing the size of the plume. The figure assumes stop of CO_2 injection after 25 years.

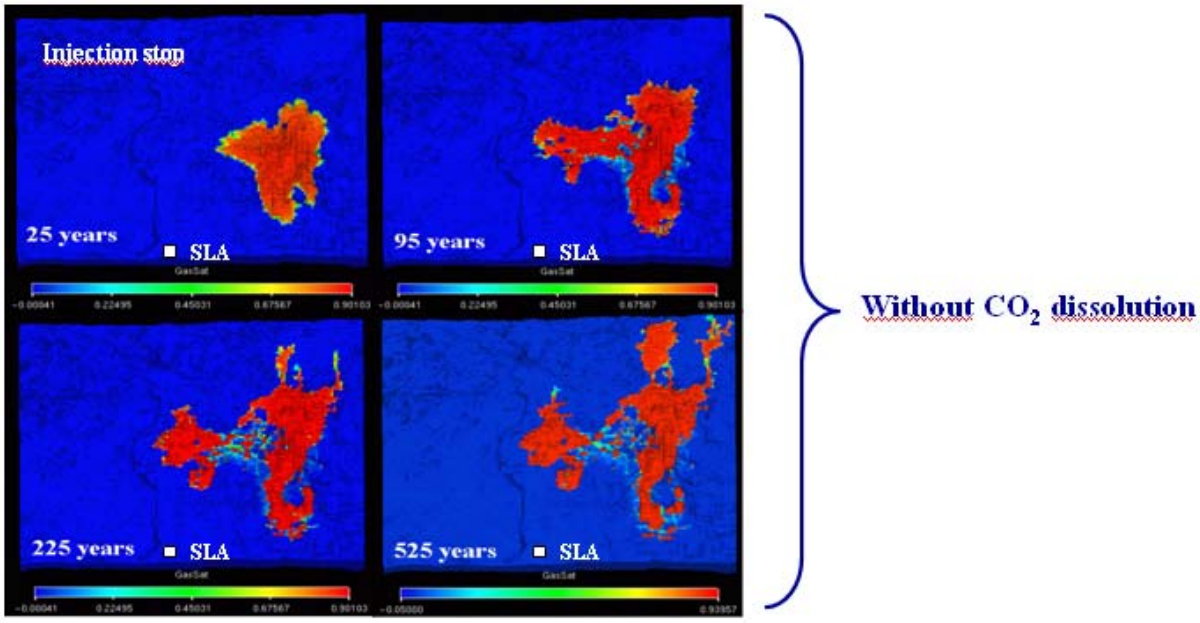


Figure 8. Simulation results seen from above without taking into account the effect of CO_2 dissolution.

Dependent on the model parameters, most of the free CO_2 will have dissolved into the aquifer after between 5000 and 50000 years.

Note that the CO_2 migrates away from the SLA platform. The migration route is controlled by the topography of the Utsira Formation/cap rock interface. This means that no production wells on Sleipner are exposed too the CO_2 plume.

1.4 Publications and conference presentations

Publications:

- **Chadwick, R.A.**; Arts, R.; Eiken, O.; **Kirby, G.A.**; Lindeberg, E.; Zweigel, P.. 2004 4D seismic imaging of an injected CO2 plume at the Sleipner Field, central North Sea. In: Davies, Richard J., (ed.) *3D seismic technology : application to the exploration of sedimentary basins.* London, UK, Geological Society of London, 311-320. (Geological Society of London Memoir, 29).
- Gale, J., Christensen, N. P., Cutler, A., & Torp, T.A., 2001: Demonstrating the Potential for Geological Storage of CO_2: The Sleipner and GESTCO Projects. Environmental Geosciences, 8 (3), 160 –165.
- Chadwick, A., Holloway, S. & Riley, N., 2001: Deep subsurface CO_2 sequestration - a viable greenhouse mitigation strategy. Geoscientist, vol 11, No 2, Feb 2001, 4-5.
- Zweigel, P. & Gale, J., 2000: Storing CO_2 underground shows promising results.- EOS, Transactions, American Geophysical Union, 81 (45), 529 & 534. (Reprinted with added figure in Earth in Space, 13 (6), 8-9.)
- Carstens, H. (& Torp, T.), 2000: Send CO2 tilbake til undergrunnen. GEO, 3, (6), 12-15.
- Zweigel, P., Lindeberg, E., & Eiken, O., 2000: 4D seismikk løser gåten. GEO, 3, (6), 16-18.

Conference presentations:

Greenhouse Gas Technology-8, Trondheim:

- Nooner et al. (in press, 2006): Constraining the density of CO2 within the Utsira formation using time-lapse gravity measurements. Extended abstract.

Offshore Europe, SPE conference 6-9 september 2005, Aberdeen, Scotland:

- Hansen, H.,Eiken, O. and Aasum, T.O, 2005: Tracing the path of the carbondioxide from a gas-condensate reservoir, through an amine plant and back into a subsurface acquifer. Case study: The Sleipner area, Norwegian North Sea

2nd Annual Conference on Carbon Sequestration, 5-8 May 2003, Alexandria, VA, US:

- Gaus, I., Azarounal, M., & Czernichowski-Lauriol, I., 2003: Reactive transport modeling of dissolved CO2 in the cap rock base during CO2 sequestration (Sleipner site, North Sea). Abstracts of the 2nd Annual Conference on Carbon Sequestration, 5-8 May 2003, Alexandria, VA, US.

6th Petroleum Geology Conference, October 2003, London

- Chadwick, R.A., R.Arts & O. Eiken, 2005, 4D seismic quantification of a growing CO2 plume at Sleipner, North Sea. In; DORÉ, A.G & VINING, B.A (eds) Petroleum Geology: North-West Europe and Global Perspectives, Proceedings of the 6th Petroleum Geology Conference, 1385-1399

6th Greenhouse Gas Control Technologies Conference (GHGT6), October 2003, Kyoto:

- Arts; R., Eiken, O., Chadwick, A., Zweigel, P., van der Meer, L., & Zinszner, B., 2002: Monitoring of CO2 Injected at Sleipner Using Time Lapse Seismic Data. Abstracts of the 6th International conference on Greenhouse Gas Control Technology (GHGT-6), Kyoto, Japan, 1-4 October 2002
- Chadwick, A., Zweigel, P., Gregersen, U., Kirby, G., & Johannessen, P., 2002: Geological Characterisation of CO2 Storage Sites: Lessons from the Sleipner, Northern North Sea. Abstracts of the 6th International conference on Greenhouse Gas Control Technology (GHGT-6), Kyoto, Japan, 1-4 October 2002
- Czernichowski-Lauriol, C.A. Rochelle, E. Brosse, N. Springer, K. Bateman, C. Kervevan, J.M. Pearce, B. Sanjuan, 2002: Reactivity of injected CO_2 with the Utsira Sand reservoir at Sleipner. Abstracts of the 6th International conference on Greenhouse Gas Control Technology (GHGT-6), Kyoto, Japan, 1-4 October 2002, p 341.
- Lindeberg, E., Bergmo, P., & Moen, A., 2002: The Long-term Fate of CO2 Injected into an Aquifer. Abstracts of the 6th International conference on Greenhouse Gas Control Technology (GHGT-6), Kyoto, Japan, 1-4 October 2002. Short abstract. Extended abstract

- Torp, T.A. & Gale, J. 2002: Demonstrating Storage of CO2 in Geological Reservoirs: The Sleipner and Sacs Projects. Abstracts of the 6th International conference on Greenhouse Gas Control Technology (GHGT-6), Kyoto, Japan, 1-4 October 2002

EAGE Annual meeting 2002, Florence:

- Arts, R., Elsayed, R., van der Meer, L., Eiken, O., Østmo, S., Chadwick, A., Kirby, G., Zinszner, B., 2002: Estimation of the mass of injected CO2 at Sleipner using time-lapse seismic data. EAGE, Annual meeting 2002, Florence, Italy.

Geological Society of London, '3D Seismic Data: Advances in the Understanding of Stratigraphic and Structural Architecture' conference, 14-16 November 2001

- Chadwick, A., Williamson, P., Zweigel, P., Arts, R., Eiken, O., 2001: Time-lapse geophysical monotoring of a subsurface CO2 bubble in the Utsira Sand, Sleipner, northgern North Sea. Presentation at '3D Seismic Data: Advances in the Understanding of Stratigraphic and Structural Architecture' conferece at the Geological Society of London, Burlington House, 14-16 November 2001.

American Association of Petroleum Geologists (AAPG), Annual Meeting, June 2001, Denver

- Eiken, O., Brevik, I., Art, R., Lindeberg, E., Fagervik, K. 2001: Seismic monitoring of CO2 injected into a marine aquifer. American Association of Petroleum Geologists, Annual Meeting, June 2001, Denver, abstract volume.
- Zweigel, P., Arts, R., Bidstrup, T., Chadwick, A., Eiken, O., Gregersen, U., Hamborg, M., Johanessen, P., Kirby, G., Kristensen, L., & Lindeberg, E., 2001: Results and experiences from the first Industrial-scale underground CO_2 sequestration case (Sleipner Field, North Sea). American Association of Petroleum Geologists, Annual Meeting, June 2001, Denver, abstract volume (CD) 6p.

European Union of Geosciences (EUG), XI meeting, April 2001, Strasbourg

- Chadwick, A., Kirby,G., Holloway, S., Zweigel, P., & Arts, R. 2001: The case for underground carbon dioxide sequestration in Northern Europe.- European Union of Geosciences, XI meeting, April 2001, Strasbourg, Abstract volume, 172.
- Czernichowski-Lauriol, I., Rochelle, C.A., Brosse, E., Springer, N., Pearce, J.M., Bateman, K.A., Sanjuan, B., Kervévan, C., 2001: Disposal of CO2 in deep aquifers: geochemical investigations of water-rock-CO2 interactions at Sleipner (North Sea) as part of the SACS project. European Union of Geosciences, XI meeting, April 2001, Strasbourg, Abstract volume, 172.

5th Greenhouse Gas Control Technologies Conference (GHGT5), August 2000, Cairns

- Arts, R., Brevik, I., Eiken, O., Sollie, R., Causse, E., & van der Meer, B. 2000b: Geophysical methods for monitoring marine aquifer CO_2 storage - Sleipner experiences. 5th International Conference on Greenhouse Gas Control Technologies, Cairns (Australia), August 2000. (PDF 922 KB / 6 pages)
- Chadwick, R.A., Holloway, S., Kirby, G.A., Gregersen, U., & Johannessen, P.N. 2000: The Utsira Sand, Central North Sea - An assessment of its potential for regional CO_2 disposal. 5th International Conference on Greenhouse Gas Control Technologies, Cairns (Australia), August 2000. (PDF 446 KB / 6 pages)
- Lindeberg, E., Zweigel, P., Bergmo, P., Ghaderi, A., & Lothe, A. 2000b: Prediction of CO_2 dispersal pattern improved by geology and reservoir simulation and verified by time lapse seismic. 5th International Conference on Greenhouse Gas Control Technologies, Cairns (Australia), August 2000. (PDF 91 KB / 6 pages)
- Pearce, J.M., Czernichowski-Lauriol, I., Rochelle, C.A., Springer, N., Brosse, E., Sanjuan, B., Bateman, K., & Lanini, S. 2000: How will reservoir and caprock react with injected CO_2 at Sleipner? Preliminary evidence from experimental investigations. 5th International Conference on Greenhouse Gas Control Technologies, Cairns (Australia), August 2000. (PDF 14 KB / 6 pages)
- Van der Meer, L.G.H., Arts, R.A., & Paterson, L. (2000): Prediction of migration of CO_2 after injection in a saline aquifer: reservoir history matching of a 4D seismic image with a compositional gas/water model. 5th International Conference on Greenhouse Gas Control Technologies, Cairns (Australia), August 2000. (PDF 14 KB / 6 pages)
- Zweigel, P., Hamborg, M., Arts, R., Lothe A., & Tømmerås, A. 2000: Prediction of migration of CO_2 injected into an underground depository: Reservoir geology and migration modelling in the Sleipner case (North Sea). 5th International Conference on Greenhouse Gas Control Technologies, Cairns (Australia), August 2000. (PDF 1170 KB / 6 pages)

SEG International Conference 2000, Calgary

- Eiken, O., Brevik, I., Arts. R., Lindeberg, E., & Fagervik, K. 2000: Seismic monitoring of CO2 injected into a marine aquifer. SEG Calgary 2000 International conference and 70th Annual meeting, Calgary. (PDF 208 KB / 4 pages)

EAGE Annual Meeting 2000, Glasgow

- Arts, R. J., Zweigel, P., & Lothe, A.E. 2000a: Reservoir geology of the Utsira Sand in the Southern Viking Graben area – a site for potential CO2 storage.- 62nd EAGE meeting, Glasgow, paper B-20. (PDF 269 KB / 4 pages)
- Brevik, I., Eiken, O., Arts, R.J., Lindeberg, E., & Causse E. 2000: Expectations and results from seismic monitoring of CO2 injection into a marine acquifer. 62nd EAGE meeting, Glasgow, paper B-21.
- Gregersen, U, Johannessen, P.N., Chadwick, R.A., Holloway, S. & Kirby, G.A. 2000: Regional study of the Neogene deposits in the southern Viking Graben area - a site for potential CO_2 storage. 62nd EAGE meeting, Glasgow. (PDF 123 KB / 4 pages)

AAPG Int'l Conf. & Exhib. 1999, Birmingham

- Zweigel, P., Lothe, A. E., & Lindeberg, E., 1999: Offshore underground CO2-disposal: Reservoir geology of the Neogene Utsira Formation, Sleipner Field, North Sea.- AAPG Bull., 83, 1346-1347. (Poster at AAPG International Conference, Birmingham, UK, September 1999)

From CO2STORE project:

Title: Sleipner/Utsira CO_2 Geological Storage Full Field Flow and Geochemical Coupling to Assess the Long Term Fate of the CO_2
Authors: Frangeul, Johann, Long Nghiem, Emmanuel Caroli, Sylvain Thibeau
Conference: AAPG Annual Meeting, Dallas USA, April 18-21, 2004
Publication: AAPG Bulletin Vol. 88 (2004), No. 13 (Supplement)
Abstract: available at AAPG
Website:http://www.searchanddiscovery.com/documents/abstracts/annual2004/Dallas/Frangeu.htm

From Saline Aquifer CO_2 Storage (SACS) project:

Geology

- Rock mechanical tests of shale samples from the cap rock of the Utsira Sand in well 15/9-A11 – A contribution to the Saline Aquifer CO_2 Storage (SACS) project. Pillitteri et al. 2003. (PDF 1.7MB)
- Seismic mapping and simulation of CO2 migration in the upper Utsira sand wedge east of the Sleipner injection site – A contribution to the Saline Aquifer CO2 Storage (SACS) project. Hamborg et al. 2003. (PDF 1.4MB)
- Studies on the likelihood for caprock fracturing in the Sleipner CO2 injection case – A contribution to the Saline Aquifer CO2 Storage (SACS) project. Zweigel & Heill 2003. (PDF 2.0MB)
- The effect of time-depth conversion procedure on key seismic horizons relevant for underground CO2 storage in the Sleipner field (North Sea). Zweigel & Hamborg 2002. (PDF 2.6 MB).
- SACS, Task 1.4: Evaluation of cap rock sealing the reservoir. Clay mineralogy investigation of core and cuttings from the Ekofisk and Sleipner areas. Lindgren et al. 2002. (PDF 513 KB).
- Characterisation of the Nordland Shale in the Sleipner area by XRD analysis - A contribution to the Saline Aquifer CO2 Storage (SACS) project. Bøe, R., & Zweigel, P. (Feb. 2001). (PDF 547 KB)
- Reservoir geology of the storage units in the Sleipner CO2 injection case. Zweigel et al (Dec 2000). (ZIP 13.5 MB). Main report only. (PDF 7926 KB)

- Mineralogical and petrographical characterisation of a 1 m core from the Utsira Formation, Central North Sea. Pearce, J.M., Kemp, S.J., and Wetton, P.D., 1999. BGS Technical Report - Mineralogy & Petrology Series, Report WG/99/24C, 26pp. + 3 plates. (ZIP 23562 KB)
- The biostratigraphical and palaeo-ecological application of calcareous microfaunas from the Utsira Formation in Norwegian Well 15/9-A-23. Wilkinson, I. P., 1999. BGS Technical Report – Stratigraphy Series, Report WH/99/124R, 4pp. (PDF 29 KB / 4 pages)

Geochemistry

- Preliminary modelling of the geochemical impact of CO_2 injection on the caprock at Sleipner. Gaus et al. 2002. (PDF 254 KB)
- The solubility of supercritical CO_2 into pure water and synthetic Utsira porewater. Rochelle & Moore 2002. (PDF 1.7 MB)
- Geochemical interactions between supercritical CO_2 and the Utsira Formation: an experimental study. Rochelle et al. 2002. (PDF 4.5 MB)

Geophysics

- Multi-component seismic monitoring of CO2 gas cloud in the Utsira Sand: A feasibility study (Report Work Area 5.6) . Liu et al. (April 2001). (PDF 1586 KB)

2 CO_2 capture from Snøhvit well stream at Hammerfest LNG and storage in the Tubåen and Stø formation in the Snøhvit area – injection well and monitoring methodology

2.1 CO_2 re-injection system and well specification:

Location of the CO_2 injection well F-2 H:

The CO_2 injection well is located at the F-segment at the western part of the Snøhvit reservoir (Figure 9). The injection pipeline is 152 km long (Figure 10).

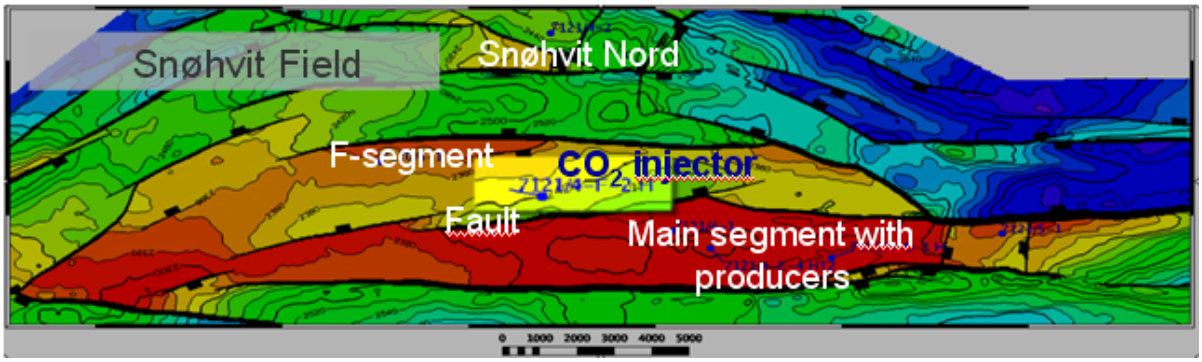


Figure 9. Location of the CO_2 well at Snøhvit.

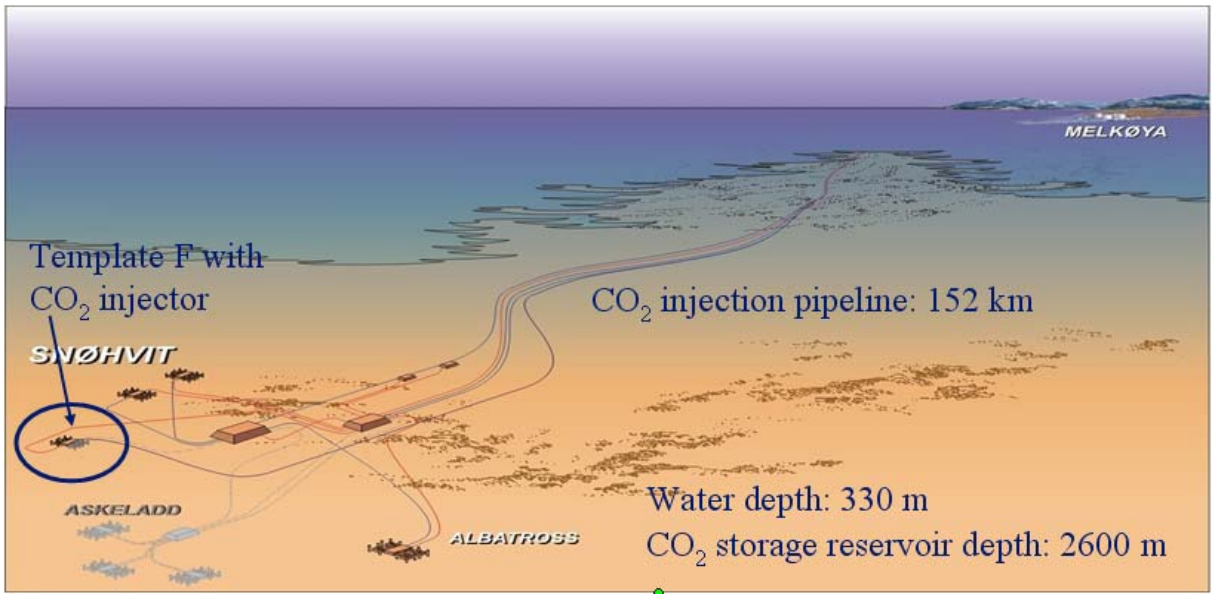


Figure 10. Field overview.

Table 1. Key parameters for F-2 H into Tubåen and Stø reservior reservoir.

Key parameters	TUBÅEN	STØ
Initial reservoir pressure	288 bar	255 bar
Initial temperature	98 °C	98 °C
Porosity	10- 16 %	15 %
Permeability	200-800 md	400 md
Reservoir depth	2600 m	2450 m
Water depth at F-template	330 m	330 m
Lenght pipline from Melkøya	152 km	152 km

To keep the CO_2 as deep as possible, it was decided to perforate the mid and lower part of Tubåen as shown in figure 11. If injection fails, additional perforations could be added in Tubåen, and/or bottom of Stø could be opened up for injection.

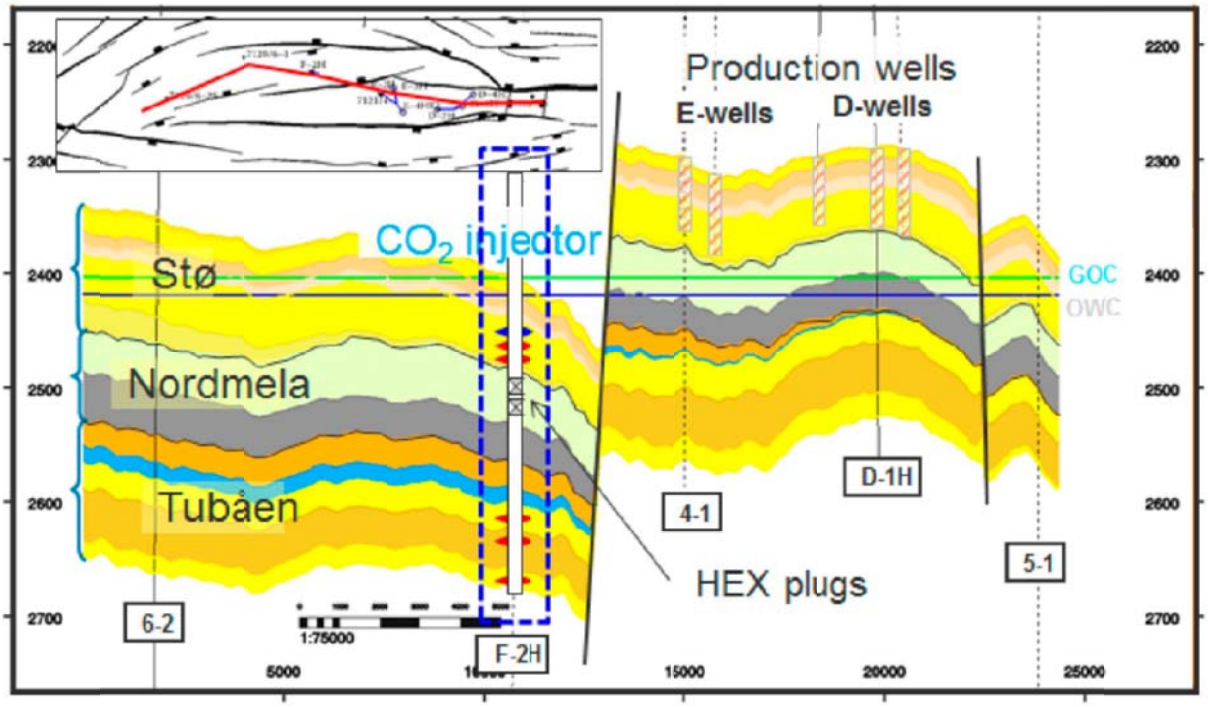


Figure 11. Cross-section of F-segment where CO_2 is injected.

The completion design basis for the CO_2 injector is a perforated 7" liner. Downhole pressure and temperature gauge is installed. At Snøhvit and Hammerfest LNG, all facilities for separation and injection of CO_2 are placed onshore at the process plant at Melkøya. CO_2 in the feed gas are removed to avoid it freezing out in the downstream liquefaction process. An amine absorption unit performs this operation. The recovered CO_2 is condensed and recompressed before re-injected into Tubåen.

A schematic of the CO_2 re-injection system is shown in Figure 12. The indicated physical and measured values are expected initial values. Figure 13 shows the CO_2 phase diagram. The eight numbers in the phase diagram show CO_2 phase conditions at eight different locations indicated in Figure 13.

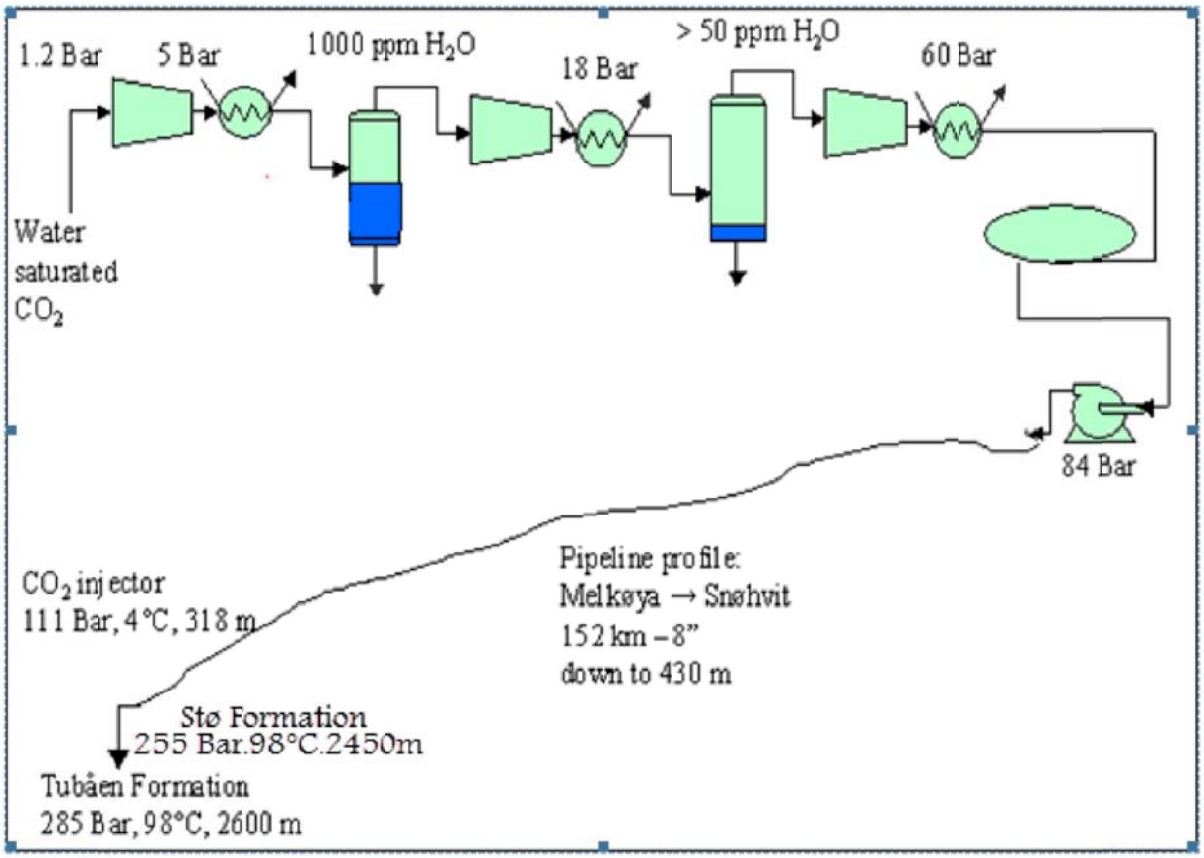


Figure 12. Schematic of the CO_2 injection system.

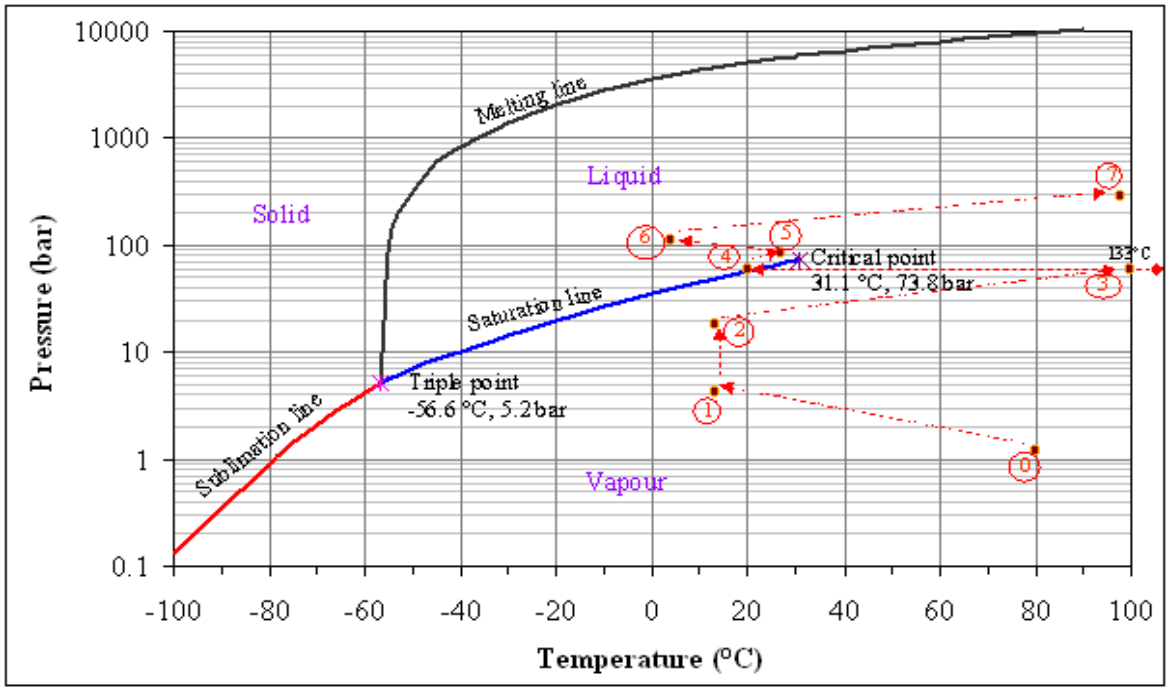


Figure 13. CO_2 phase diagram with eight phase conditions identified in the injection system in the Snøhvit area.

The figures (12 and 13) show that CO_2 most likely are re-injected as a single phase (liquid condition in the pipeline from the export pump (5) to the well head (6), transformed to supercritical condition in the reservoir where the temperature is higher).

CO_2 well stream specification

- o >99% CO_2
- o max 100 ppm (mol) H2S
- o max 50 ppm (wt) H2O
- o traces of HC and N2

CO_2 venting to atmosphere:

CO_2 venting is foreseen in case of shut down of the CO_2 reinjection system. The maximum vent rate is almost equal to the CO_2 removal flow rate. A separate vent stack for the CO_2 is provided at the plant.

2.2 Applied methods for monitoring the injected CO_2

a) Seismic monitoring

- 3D seismic shot in 2003
- 2D line shot in 2006
- 3D/4D seismic monitoring survey acquired in 2009
- Possible 3D/4D seismic in 2012

b) Gravimetric monitoring

- Pre-installed 41 concrete benchmarks across the Snøhvit reservoir in 2007
- The closest is 419 m from the CO_2 well
- Repeat survey carried out in 2011 confirmed the prognoses

Benchmark number 21 is closest to the CO_2 injection well – see figure 14.

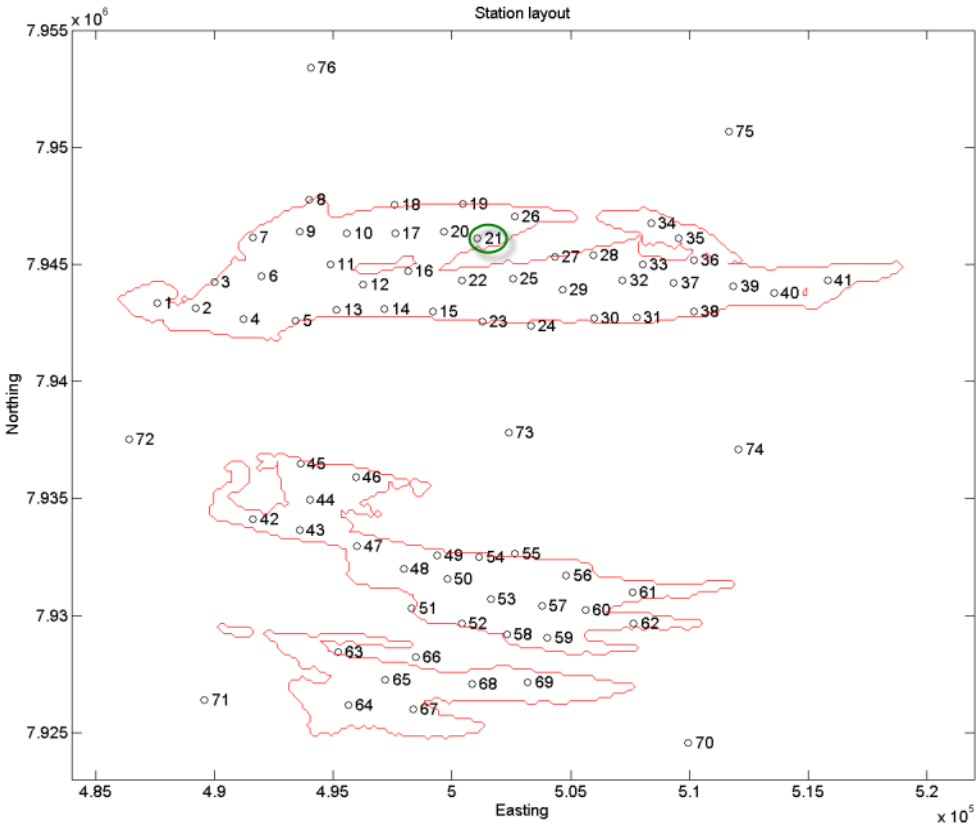


Figure 14. Benchmarks Gravimetric monitoring CO_2 storage in the Snøhvit area.

c) Pressure measurements

Pressure and temperature gauge is installed in the well 800 metres above top reservoir and the pressure development in the injection well F-2 H is monitored on a daily basis. Data are used in history matching of the reservoir simulation model.

Annex V: National Greenhouse Gas Inventory System in Norway

Information about changes in the document

Version	Date	Performed by	Comment	
1	01.11.2006	Norwegian Pollution Control Authority	Part of the initial report 2006	
2	15.04.2010	Climate and Pollution Agency	Updates to 2010 Submission	
3	25.05.2012	Climate and Pollution Agency	Updates to 2012 Submission	
4	01.04.2013	Climate and Pollution Agency	Updates to 2013 Submission	

Version 4

2013

Contents

Preface

According to the decision on Article 5.1 of the Kyoto Protocol all Annex 1 parties (industrialized countries) must implement a national system for greenhouse gas inventories, which includes (see Annex to decision 19/CMP.1):

> "*all institutional, legal and procedural arrangements made within a Party included in Annex I [to the Kyoto Protocol] for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information*"

A description of this national system must be reported as part of a country's Initial Report to the Kyoto Protocol, see decision 13/CMP.1. The purpose of the Initial Report is to facilitate calculation of assigned amount and demonstrate the capacity to account for emissions, removals and assigned amount. The Initial Report was submitted to the Climate Convention before 1 January 2007. The report on the national system for greenhouse gas inventories will be attached to this Initial Report as an appendix.

The report on national system for greenhouse gas inventories has been prepared by a project team consisting of representatives from the Climate and Pollution Agency, Statistics Norway, the Center for International Climate and Environmental Research – Oslo (CICERO) and The Norwegian Forest and Landscape Institute.

1 Introduction

A national system for greenhouse gas inventories is introduced in Article 5.1 of the Kyoto Protocol. The objectives of the national system are[1]:

- To enable Annex I Parties to estimate anthropogenic greenhouse gas (GHG) emissions by sources and removals by sinks in accordance with the Kyoto Protocol and decisions made by the Parties
- To assist Annex I Parties in meeting their commitments
- To facilitate review of the submitted information
- To assist Annex I Parties to ensure and improve the quality of their inventories

The Guidelines for national systems are defined in the Annex to COP[2]/MOP[3] decisions 20/CP.7 and 19/CMP.1 (FCCC/CP/2001/13/Add.3). These guidelines describe various functions that need to be in place in the national system, but leave the details of implementation to each Party in accordance with their national circumstances.

The functions are described as *general and specific* functions.

The general functions include:

- Establishing and maintaining *institutional, legal and procedural arrangements* necessary to perform the functions defined in the guidelines for national systems.
- Ensuring s*ufficient capacity* for timely performance of the functions defined in the guidelines, including data collection and arrangements for technical competence of the staff involved in the inventory development process.
- *Preparing national greenhouse gas inventories* and supplementary information *in a timely manne*r in accordance with the Kyoto Protocol and relevant decisions by the Parties.
- Providing information necessary to meet the *reporting requirements*.

The specific functions include:

- **Planning**
  - Designate a single *national entity*.
  - Define and allocate s*pecific responsibilities* in the inventory preparation and development process including methodological choice, data collection, processing and archiving, and quality assurance and quality control (QA/QC).

[1] Annex to COP decision 20/CP.7 and COP/MOP decision 19/CMP.1 "Guidelines for national systems for the estimation of anthropogenic greenhouse gas emissions by sources and removals by sinks under Article 5, paragraph 1, of the Kyoto Protocol" here called "guidelines for national systems".

[2] Conference of the Parties to the United Nations Framework Convention on Climate Change.

[3] Meeting of Parties to the Kyoto Protocol.

- Elaborate a *QA/QC plan* describing specific QA/QC procedures to be implemented during the inventory preparation and development process, facilitate the overall QA/QC procedures to be conducted, and establish data quality objectives.
- Establish a process for the *official consideration* and approval of the greenhouse gas inventory, including recalculations, prior to submission, and to respond to any issues raised by the inventory review process.

- **Preparation**

- Identify *key categories*
- Prepare estimates in accordance with the Revised 1996 Guidelines and the good practice guidance
- Collect sufficient data (activity data and emission factors) to support the selected methods
- Make a qualitative estimate of inventory uncertainty
- Ensure that recalculations of previously submitted estimates are made in accordance with the good practice guidance
- Compile the national inventory
- Implement general QC procedures
- Consider source-specific QC procedures and provide for a basic review of the inventory of personnel that have not been included in the inventory development.

- **Management**

- Archive information for each year in accordance with relevant decisions.
- Provide a review team with access to archived information used by the Party
- Respond to requests for clarifying inventory information resulting from different stages of the review process in a timely manner.

Good practice is in the guidelines for national systems defined as *a set of procedures intended to ensure that greenhouse gas inventories are accurate in the sense that they are systematically neither over- nor underestimates as far as can be judged, and that uncertainties are reduced as far as possible.* Guidance on preparing greenhouse gas inventories is given in the 1996 IPCC Revised Guidelines for Inventory Preparation (IPCC, 1996) and the IPCC Good Practice Guidance for Uncertainty Management in National Greenhouse Gas Inventories from 2000 (IPCC, 2000). The most extensive guidelines on QA/QC and resource prioritization are given in the latter report, which in this document is referred to as the “good practice guidance”. For the land use, land-use change and forestry (LULUCF) sector, the IPCC has prepared a supplementary good practice report in 2004 (IPCC, 2004).

The Parties to the UN Framework Convention on Climate Change (UNFCCC) have agreed on guidelines for reporting data on emissions and removals, building on the

guidance described in the IPCC reports listed in the previous paragraph.[4] Data are to be reported annually before April 15 to the UNFCCC. Reporting includes tables (using the so-called Common Reporting Format (CRF)), the National Inventory Report (NIR) describing data, methodologies and the main results of the inventory and additional documentation. For LULUCF, reporting under the Kyoto Protocol will be different from that under the UNFCCC.

This report describes how the functions required for the national system are implemented in Norway.

2 National responsibilities

2.1 General overview

The Norwegian national system for greenhouse gas inventories is based on existing cooperation. The National entity, the Climate and Pollution Agency, and Statistics Norway and The Norwegian Forest and Landscape Institute are the core institutions in the national system.

The Norwegian greenhouse gas inventory has been produced in more than two decades in collaboration between Statistics Norway and the Climate and Pollution Agency. The reporting to the UNFCCC has been based on this greenhouse gas inventory.

Statistics Norway is responsible for the official statistics on emissions to air.

The Norwegian Forest and Landscape Institute is responsible for the calculations of emission and removals from Land Use and Land Use Change and Forestry - LULUCF.

2.2 Legal basis

The data collection and data management is secured through three main acts, the Pollution Control Act (forurensningsloven), the Greenhouse Gas Emission Trading Act (klimakvoteloven) and the Statistics Act (statistikkloven).

The *Pollution Control Act* gives the Climate and Pollution Agency the authority to collect and review emission data from large industrial plants (http://odin.dep.no/md/engelsk/regelverk/lover/022051-200014/dok-bn.html). Greenhouse gases are considered part of the Pollution Control Act. The Pollution Control Act is a typical enabling act. This means that the details in each case are outlined in discharge permits and regulations issued by the pollution control authorities. The Act was established for the purpose of preventing and reducing harm and nuisance from pollution. This is reflected in the main rule of the act, which says that pollution is forbidden, unless it is specifically permitted by law, regulations or individual permits. Particular relevant extracts of this act for the national system are shown in Annex 1.

Collection and checking of GHG emission data are also covered by the *Greenhouse Gas Emission Trading Act* (http://odin.dep.no/md/english/doc/regelverk/acts/022051-200015/dok-bn.html). Chapter 4 of this act addresses reporting and control. The relevant

[4] Guidelines for National Communications by Parties included in Annex I to the Convention, Part I: UNFCCC Reporting Guidelines on Annual Inventories. FCCC/CP/2002/7/Add.2.

extract is shown in Annex 2. The implementation rules are stipulated in a regulation (in Norwegian only). An explanation of this regulation is given in Annex 3.

Statistics Norway is a professional independent institution, which through The Statistics Act has been given the right to impose upon any person, firm or governmental institution an obligation to provide information necessary for the production of official statistics. The Statistics Act gives Statistics Norway unlimited access to administrative registers and to choose the statistical methods which form the basis for the preparation of official statistics. Statistics Norway is responsible for how and when official statistics are published. The Ministry of Finance is administratively responsible for Statistics Norway, and fiscal budget for its business is set by the Government and the Norwegian parliament.

The parts of the Statistics Act most relevant for the national system are shown in Annex 4.

2.3 The Climate and Pollution Agency's responsibilities as national entity

The Climate and Pollution Agency has been appointed by the Ministry of the Environment as the national entity through the budget proposition to the Norwegian parliament (Stortinget) for 2006, which states that "*The Norwegian system will build on existing cooperation between Norwegian Pollution Control Authority (now the Climate and Pollution Agency) and i.a. Statistics Norway. On this background Norwegian Pollution Control Authority is appointed as a national entity with overall responsibility for the inventory and reporting*". (St. prop. Nr. 1 (2005-2006)). This point of the proposition has been accepted by the Norwegian parliament without any remarks. The national system is built around well-established institutional cooperation.

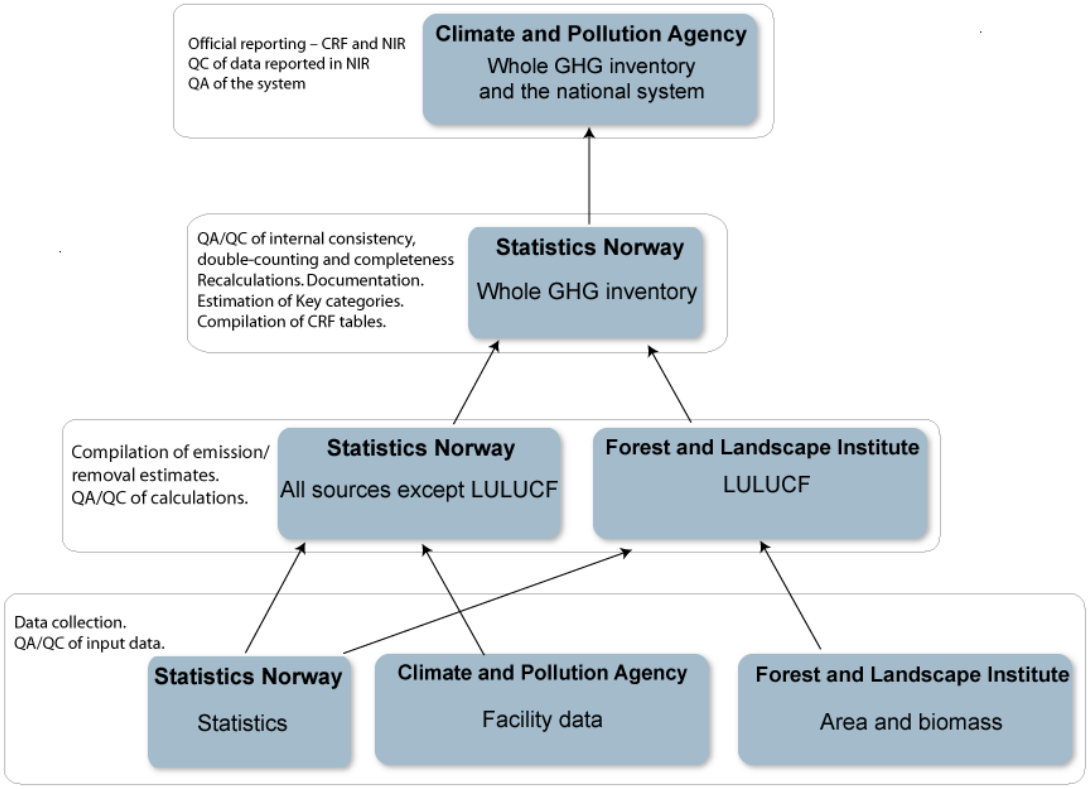
The Climate and Pollution Agency as a national entity are responsible for:

- Reporting the greenhouse gas inventory to the UNFCCC, including the National Inventory Report and CRF tables
- Completing the National Inventory Report
- Implementation of the QA/QC plan
- Preparing for UNFCCC inventory reviews and coordinating the communication with the expert review team, including responses to review findings
- Coordinating the cooperative work between the core institutions, including the establishment of formal agreements
- Informing the cooperating institutions about relevant decisions and meetings
- Informing national institutions (e.g. ministries and data providers) about the requirements of the national system and ensuring that existing information in national institutions is considered and used in the inventory where appropriate
- Working to secure adequate funding for all parts of the national system in collaboration with the Ministry of the Environment, The Ministry of Agriculture and Food and the Ministry of Finance.

2.4 Institutional cooperation, responsibilities and agreements

The three core institutions, the Climate and Pollution Agency, Statistics Norway and The Norwegian Forest and Landscape Institute, work together to fulfill the requirements for the national system. The allocation of responsibilities for producing estimates of emissions and removals, QA/QC and archiving is presented in chapter 3, 4 and 5. An overview is shown in Figure 1.

Figure 1. Overview of institutional responsibilities and cooperation



To ensure that the institutions comply with their responsibilities, Statistics Norway and The Norwegian Forest and Landscape Institute have signed agreements with the Climate and Pollution Agency as a national entity. The Forest and Landscape Institute's obligations will also be guided by the annual allotment letter (*tildelingsbrev*) from the Ministry of Agriculture and Food. Through these agreements, the institutions are committed to implementing the QA/QC and archiving procedures, providing documentation, making information available for review, and delivering data and information in a timely manner to meet the deadline for reporting to the UNFCCC.[5]

The establishment of the national system requires close collaboration between the three institutions. Two annual cooperation meetings have been formalized.[6] The

[5] The agreement between Norwegian Pollution Control Authority and Statistics Norway also includes commitments for data deliveries for reporting under the Convention on Long-range Transboundary Air Pollution (LRTAP).

[6] A proposal has been made to have one meeting in the early autumn and another in January/February. Extraordinary meetings may be held as needed.

Climate and Pollution Agency as a national entity is responsible for preparing, organizing and reporting from these meetings. The purpose of the cooperation meetings is to discuss and agree on methodological issues, prioritize resources (e.g. in light of the review reports) and generally facilitate the implementation of the national system. The cooperation meeting takes decisions collectively.

More specifically the cooperation meetings will

- Prepare for the annual review and address comments received
- Agree on methodological changes in light of review reports, QA/QC findings, new scientific information and available resources
- Agree to implement new data into the inventory
- Agree to recalculations and appropriate methodologies
- Prioritize source-specific QC and methodology studies to improve the estimates in the short and long-term
- Prioritize and interpret QA-procedures
- Review documentation and QA/QC and archiving systems and point out needs for improvements
- Address other relevant technical issues
- Point out weaknesses in capacity
- Point out problems with the implementation of the national systems (institutional and overall)
- Exchange relevant information
- Report the conclusions from the meetings and flag issues for follow-up to the responsible heads of departments in the three institutions

The key data providers are shown in Annex 5. As can be seen, most of the key data are collected by the three core institutions. Additional key data providers include the Norwegian Petroleum Directorate, the Norwegian Petroleum Industry Association, and the Norwegian Road Federation.

2.5 Official consideration and approval of the inventory

The Climate and Pollution Agency as the national entity is in charge of approving the inventory before official submission to the UNFCCC. As a basis for approving the inventory, the Climate and Pollution Agency will consider the completion of the inventory and the National Inventory Report. The Climate and Pollution Agency will also review

- The QA/QC report from the QA/QC responsible in the Climate and Pollution Agency, attaching QA/QC reports from the core institutions
- Methodological changes and recalculations
- Minutes from the cooperation meetings between the institutions
- Other matters of relevance for the approval of the inventory

2.6 Inventory production plan

The core institutions have agreed on a “milestone” production plan (Table 1). The plan will be supplemented by internal production plans in the three core institutions.

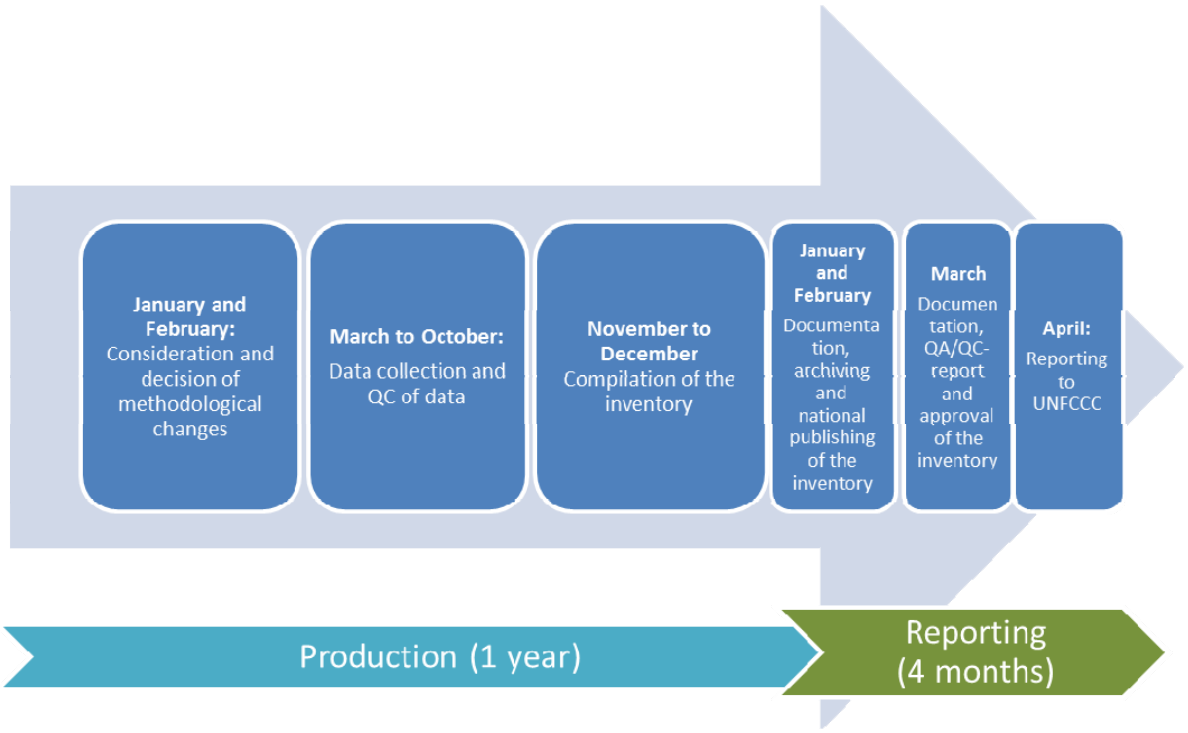
Table 1. Inventory production plan, milestones

	Responsible	**Deadline**
Consideration of methodological changes needed for the next year's reporting, including those based on the review report from last years reporting round	Climate and Pollution Agency[3]	Feb. 1
Agreement on major methodological changes needed for next year's reporting	All	May 15
Preliminary emissions data from plants sent to Statistics Norway	Climate and Pollution Agency	May 1
Final emissions from large industrial plants sent to Statistics Norway	Climate and Pollution Agency	Oct.
All LULUCF data collection for the previous calendar year completed	Forest and Landscape	Sept. 1
All non-LULUCF data collection completed	Statistics Norway	Nov. 1
LULUCF inventory for the previous calendar year sent to Statistics Norway in CRF format	Forest and Landscape	Feb. 15
Test runs, QA/QC (excluded LULUCF)	Statistics Norway	Nov. 15
Draft inventory to Climate and Pollution Agency for comments and QA/QC (excluded LULUCF)	Statistics Norway	Dec. 5
Final inventory including completion of QA/QC tests and recalculations (excluded LULUCF)	Statistics Norway	Jan. 15
Review of documentation and necessary updates made[1]	All	Feb. 1
NIR 1st draft	Climate and Pollution Agency and Forest and Landscape	March 1
Completion of CRF tables [2]	Statistics Norway	March 15
QA/QC reports sent to the Climate and Pollution Agency	All	March 20
NIR finalized	Climate and Pollution Agency	April 1
QA/QC report finalized	Klif[3]Climate and Pollution Agency	April 1
Formal approval of inventory for the purpose of reporting	Climate and Pollution Agency	April 10
Reporting	Climate and Pollution Agency	April 15

[1] This point includes internal documentation in all institutions while Statistics Norway and The Norwegian Forest and Landscape Institute are responsible for external documentation

[2] Statistics Norway will send complete CRF tables to the Climate and Pollution Agency, data originally collected by the Climate and Pollution Agency are sent to Statistics Norway who is responsible for making these data available in the CRF.

Figure 2 The inventory preparation cycle



2.7 Securing and developing capacity

Norwegian authorities will secure financial and human capacity to the national system to fulfill the reporting obligations and ensure that the data quality objectives are met.

The Climate and Pollution Agency is a government institution. Their responsibility for the national system will be described in the annual letter from the Ministry of the Environment where they give directions on the Climate and Pollution Agency's key priorities and financial resources for the following year. The national system will involve several units in the Climate and Pollution Agency. To ensure that the requirements are met, the Climate and Pollution Agency has established an internal project group for the national system.

Statistics Norway is an independent government institution. The production of the emission inventory is a permanent responsibility for Statistics Norway. The expenses for production and development of the emission inventory are partly covered by Statistics Norway through its financing from the government budget, and partly through specific project funding from the Climate and Pollution Agency.

The Norwegian Forest and Landscape Institute is an independent government institution. The institution is mainly funded through the Ministry of Agriculture and Food. Several units within the institution will be involved in the LULUCF inventory, but the responsibility for coordination, QA/QC and reporting will be placed within one of these units. The expenses for production and development of the greenhouse gas inventory are partly covered by the Norwegian Forest and Landscape Institute

through its funding over the government budget and partly through specific project funding from the Climate and Pollution Agency.

Each institution is obliged to implement internal procedures to fulfill the requirements of the national system, in particular with respect to meeting deadlines, implementation of QA/QC procedures and archiving. Each institution is also obliged to develop the competence of their staff as required.

In addition to the cooperation meetings, the three institutions will meet to discuss and share experiences with respect to key topics like QA/QC, uncertainty assessment, archiving and the Kyoto Protocol. These meetings will be used to increase the capacity in the project groups in the three institutions. The core institutions of the national system may also need to seek partners with particular knowledge to participate in a Tier 2 QA/QC and improve methodologies and data, for example with respect to industrial processes technology, agriculture, soil processes and waste.

3 QA/QC-plan

Data quality objectives

Good practice defines the data quality objectives to be *transparency, completeness, consistency, comparability and accuracy*. These objectives are used as a foundation of the QA/QC system to be implemented in Norway. In addition we consider *timeliness* as part of the data quality objectives. Below we describe the objectives in more detail as they have been elaborated for the national system in Norway:

Transparency implies:

- Availability of sufficient documentation to enable estimates to be replicable from emission factors, activity data or plant emission measurement[7] for emission/removal data, irrespective of which institution or company made the estimates. This includes appropriate references to supplementary information (e.g. scientific literature).
- Availability of supplementary documentation (in English if practical) of models to enable a review, including a description of main assumptions and sources of data.
- Availability of supplementary documentation (in English if practical) of data collection of key activity data.
- Availability of sufficient documentation of methodological choices, including choice of measurement methods.
- Explanation of reasons for not estimating an emission or removal occurring in Norway, for example an explanation of why an estimate is considered negligible.
- Documentation of QA/QC procedures.

[8] This criterion can be difficult to fulfill in cases where complex models are used.

Completeness implies that:

- Estimates are made for all sources and sinks identified unless it can be documented that emissions/removals are negligible.
- Notation keys are used for all cells to be reported in the CRF.
- Reviews are regularly undertaken to assess potential new sources and include these in the inventory.

Consistency implies that:

- The same data sources and assumptions are used across gases, sectors and years of the inventory.
- The same methodology has been used for all years of a time-series.
- Data (activity data and measured data) have been collected using the same method for all years of the time-series.
- Appropriate splicing techniques in accordance with the good practice guidance have been applied in cases of inconsistencies of time-series or changes in methodologies.

Comparability implies that:

- Methodologies are consistent with the IPCC Guidelines and the good practice guidance.
- Reporting guidelines are followed.
- Emissions and removals are allocated to appropriate categories of the CRF as described in the IPCC Guidelines and good practice guidance.

Accuracy implies that:

- Uncertainties are reduced by selecting higher tiers for key categories or increased sampling /frequency of surveyed data and emission measurements (taking costs into account).
- Data collected are checked to assess their reliability and possible under- or underestimates and identified biases are reduced.
- Uncertainty estimates are collected and reported for all data.
- Data are compared with independent information where possible.

Timeliness implies that:

- Data are collected, processed and reported in accordance with a timetable that allows reporting within the official deadline for submission to the UNFCCC.

3.1 QA/QC responsibilities

All three institutions are responsible for implementing QC procedures to meet the data quality objectives of the data they collect. Each institution is also responsible for implementing QA-procedures of data originally collected by another institution in addition to reviewing the QC performed on these data by the institution collecting the data.

The Climate and Pollution Agency as the national entity is responsible for overall QC and in charge of checking on an annual basis that the appropriate QC procedures are implemented internally in the Climate and Pollution Agency and in Statistics Norway and The Norwegian Forest and Landscape Institute. Statistics Norway has an overall responsibility for QC of the data of the emission inventory, including the estimate of total emissions. The Climate and Pollution Agency will check the QC reports and may request Statistics Norway to revise the inventory if and only if, the QC report is not satisfactory, if they have identified errors in the inventory, or if any of the methodologies used are not as agreed by the cooperation meeting. In the case of a disagreement between the Climate and Pollution Agency and Statistics Norway on any numbers of the emission inventory, the Climate and Pollution Agency may change the estimates in the CRF. They will inform Statistics Norway about this decision and the reasons for it, and they will document in the NIR why the data in the CRF are different from those of the national inventory compiled by Statistics Norway.

Each institution is responsible for reporting on their completion of the QC procedures on an annual basis and before March 1. This reporting is based on a checklist of general and source-specific QC checks and a textual description of possible recalculations, issues to be followed up before the next submissions, and other relevant information. The QC report is sent to the Climate and Pollution Agency with a copy to Statistics Norway. In addition the Climate and Pollution Agency needs to complete the QC report as a basis of approval of the inventory and for information to Statistics Norway.

The Climate and Pollution Agency as the national entity is responsible for the overall QA of the national system, including the UNFCCC reviews and any national reviews undertaken.

3.2 QC procedures

The input data used in the Norwegian national inventory are classified as emission factors and other estimation parameters, activity data (statistical data) and emissions from industrial and large plants (point sources). The output is classified as estimated emissions and removals, CRF tables and NIR information. QC procedures are established for each element of input data and output.

Chapter 8 of the IPCC good practice guidance (IPCC, 2000) gives guidance on QC. Consistent information for LULUCF is given in chapter 5.5 of the good practice guidance for LULUCF (IPCC, 2004).

QC is defined *as a system of routine technical activities, to measure and control the quality of the inventory as it is being developed.* The QC system is designed to:

i) Provide routine and consistent checks to ensure data integrity, correctness, and completeness;
ii) Identify and address errors and omissions;
iii) Document and archive inventory material and record all QC activities

The IPCC good practice guidance distinguishes between *general* and *source-specific* QC procedures. The general procedures focus on the processing, handling, and documentation procedures that are common to all inventory source categories. The source-category specific QC procedures are directed at specific types of data used in the methods for individual source-categories and require knowledge of the source-category, the types of data available and the parameters associated with emissions.

3.2.1 General QC procedures

The general QC procedures are performed annually for all data collected and all estimated data. Most of these checks are performed automatically through use of Statistics Norway's emission model. However, checks are also performed manually on some data, for example emission data collected from plants and activity data, emission factors and other estimation parameters for key categories. Identified problems are normally corrected before the final submission or flagged for correction in the next submission.

In 2011, new routines for input data control were completed and implemented. Reported emissions, emission factors and activity data for the latest inventory year are now routinely compared to those of the previous inventory year. Changes larger than 50-185 %, depending on gas and source, are automatically flagged for further manual QC. In addition, implied emissions factors are calculated for emissions from stationary combustion at point sources. The IEFs are subjected to the same comparison between t and t-1.The most thorough checks are made for the gases and categories with the largest contribution to total emissions.

Furthermore, result control routines have been extended to include comparison of emission estimates at the level of IPCC and NFR reporting. Up to now the comparison has been performed for national source categories.

The general checks are summarized in Table 2.

Table 2. General annual QC checks

Check	Responsible
Time-series and inventory version comparisons to detect problems with units, computational errors as well as other human errors.	
Compare all emissions reported from industrial and other large plants to those of the previous inventory year and flag changes of more than 20% (10% for plants included in emission trading) for further QC in collaboration with the plant.	The Climate and Pollution Agency
Time series check of input data: Compare non-LULUCF input data (reported emissions, emission factors and activity data) for the latest inventory year to those of the previous inventory year. Changes larger than 50-185 %, depending on gas and source, is flagged for further QC. The most thorough checks are made for the gases and categories with the largest contribution to total emissions.	Statistics Norway

Inventory version check of input data: Compare non-LULUCF input data (reported emissions, emission factors and activity data) to previous estimates for the same inventory year[8].	Statistics Norway
Time series check of emissions, 1: Compare estimated emissions to those of previous inventory year at the level of IPCC reporting and flag changes of more than 50 % for further QC.[9]	Statistics Norway
Time series check of emissions, 2: Compare all estimated emissions to those of previous inventory year at the level of IPCC reporting and flag changes of more than 0.1% of total emission of the gas for further QC.[10]	Statistics Norway
Inventory version check of emissions: Compare all estimated emissions to previous estimates for the same inventory year[11] at the level of IPCC reporting and flag changes of more than 0.1% for further QC.	Statistics Norway
Inventory version check of emissions: Compare all estimated emissions to previous estimates for the same inventory year[12] at the level of IPCC reporting and flag changes of more than 0.1% of total emission of the gas for further QC.	Statistics Norway
Compare all LULUCF model input data (emission factors, other estimation parameters and activity data) to those of previous inventory years and flag changes of more than 3% for categories not changing land use and 20% for categories of land-use change for further QC.	The Norwegian Forest and Landscape Institute
Compare all LULUCF model input data (emission factors, other estimation parameters and activity data) to previous estimates for the same inventory year and flag changes of more than 1% for further QC.	The Norwegian Forest and Landscape Institute
Compare all estimated emissions and removals from LULUCF to previous inventory years and flag changes of more than 5% for further QC.	The Norwegian Forest and Landscape Institute
Completeness checks	
Identify large plants previously included in the inventory that no longer are included (and explain the reason for exclusion) and new plants included in the inventory (including an explanation of whether this plant is new) and communicate this information to Statistics Norway.	The Climate and Pollution Agency
Check that aggregate energy use in the emission model reflect the most recent energy balance.	Statistics Norway
Check the difference between estimated fuel use for road transport with fuel sales.	Statistics Norway
Flag incomplete categories through use of the emission model and data reported	Statistics

[8] Norway is preparing a preliminary inventory shortly after the inventory year. The comparison is made for all inventory years for which a previous estimate is available, that is all but the most recent year.

[9] 80-125 % for CO_2, 60-167 % for CH_4 and N_2O and 30-133 % for HFCs, PFCs and SF_6.

[10] 80-125 % for CO_2, 60-167 % for CH_4 and N_2O and 30-133 % for HFCs, PFCs and SF_6.

[11] Norway is preparing a preliminary inventory shortly after the inventory year.

[12] Norway is preparing a preliminary inventory shortly after the inventory year.

for previous years. Empty cells are subject to additional checks.	Norway
Check that all cells with energy consumption have a corresponding emission factor.	Statistics Norway
Check for completeness/double-counting with emission data reported from industrial plants by ensuring that the corresponding energy use is appropriately subtracted from the energy data of the emission model.	Statistics Norway
Check for completeness/double-counting between the LULUCF inventory and the inventory of other sources.	Statistics Norway
Flag incomplete categories of the LULUCF inventory by comparing to the previous inventory.	The Norwegian Forest and Landscape Institute
Consistency checks	
Comparison of emissions in the main emission model with totals estimated in sub-model (e.g. road transport and waste models).	Statistics Norway
Check for consistency where the same data are used in more than one category (SSB). The emission model of SSB is designed to avoid duplicating data by entering of the same data only once. This check also includes consistency checks between data used by Klif and The Norwegian F & L Institute with data used for the other categories.	Statistics Norway
Checks for time-series consistency in cases where emissions from plants collected by Klif only are available for parts of the time-series.	Statistics Norway
Checks for time-series consistency where activity data are only available on a non-annual or cyclical bases.	The Norwegian Forest and Landscape Institute (Statistics Norway and the Climate and Pollution Agency)
Recalculations	
Check that appropriate recalculations are made, if needed, whenever methodologies or data sources have changed.	All
Check that appropriate recalculations are made when preliminary data have been replaced with final data.	All (The Norwegian Forest and Landscape Institute in particular)
Check that when recalculations are performed these are made consistently throughout the time-series.	All
Check that where splicing techniques are needed, these are applied in accordance with good practice and are documented.	All
Documentation	
Check documentation for completeness and need for general revisions	All

3.2.2 Category-specific QC

These checks are normally not performed on an annual basis, but are performed regularly and in addition to the general QC checks. The goal is to perform a category-specific QC, including an updated uncertainty analysis, within cycles of approximately 5 years for key categories and potential key categories, and at least every 10 years for other categories. An annual and long-term prioritization will be made annually by the Climate and Pollution Agency, Statistics Norway and The Norwegian Forest and Landscape Institute, in collaboration with other relevant authorities, as a part of the improvement plan (with the Climate and Pollution Agency in charge) (see Section 3.6). For example, the review reports, QA/QC conclusions and need for improved emission data for emission reduction plans will be important for a final prioritization. QC findings are followed up by revising emission factors, activity data, other estimation parameters or the methodologies. The changes are approved in the autumn meeting between the Climate and Pollution Agency, Statistics Norway and The Forest and Landscape Institute.

Estimated emissions and removals

The QC checks on emission and removal estimates come in addition to those undertaken on the input data as described below.

The QC checks of estimates include:

- A comparison of the methodologies used to estimate emissions and removals with those recommended in the newest Guidelines
- A review of availability of data and resource requirements for selecting a higher tier
- A review of alternative methodologies
- A comparison of (higher tier) estimates with lower tiers
- A comparison of estimates to those of inventories from countries with similar national circumstances using appropriate drivers.
- An assessment of time-series consistency (for example, that the same method has been used for all years of the time-series) and use of splicing techniques (where relevant)
- A review and documentation of model assumptions
- A review and update of documentation, including archiving of supplementary documentation
- A check of whether the allocation to categories in the CRF is correct

QC checks for completeness include:

- A review of relevant emission sources not included in the inventory (the Guidelines, inventories from countries with similar national circumstances, literature)
- A review of methodologies and data availability for these potential sources
- A documentation of reasons for not including a source in the inventory

Emission data reported from plants

Plant emission data that are used in the emission trading system will undergo annual QC checks. The source-specific QC checks for other plants are performed less frequently (every 3 years) for emission estimates within key categories which account for 25-30 % of the total of that (key) category. The frequency of checking of non-key plants which are not included in the emission trading scheme is every 5 years. Statistics Norway is responsible for reporting the results of the key category analysis to the Climate and Pollution Agency, while the Climate and Pollution Agency will perform the assessment of the "key plants" within a category.

The QC checks include:

- An assessment of the internal QC/QC of the plants reporting data to the Climate and Pollution Agency
    - Their QA/QC system including archiving
    - Any changes to the QA/QC system
- An assessment and documentation of measurements and sampling
    - Measurement frequency
    - Sampling
    - Use of standards (e.g. ISO)
    - Documentation for archiving
- An assessment and explanation of changes in emissions over time (e.g. changes in technology, production level or fuels) (annual check)
- An assessment of time-series consistency back to 1990 in cooperation with Statistics Norway[13] (if plant emission data are missing for some years and estimates are made using aggregate activity data and emission factors)
- A comparison of plant emissions to production ratios with those of other plants, including explanations of differences
- A comparison of the production level and/or fuel consumption with independent statistics (in collaboration with Statistics Norway)
- An assessment of reported uncertainties (including statistical and non-statistical errors) to the extent this has been included in the reporting

The QC checks should be made in close cooperation with the emission reporting plants.

Emission factors & other estimation parameters

The category specific QC will be performed by the Climate and Pollution Agency, Statistics Norway, The Forest and Landscape Institute and/or another institution with expertise in the category subject to review. It can address a single category or several

[13] For plants included in the emission trading scheme historical data are derived in cooperation with the industry organization

related categories (e.g. road transportation, LULUCF and agriculture) and will include an assessment of the emissions factors currently in use and conclude on the need for revisions.

This QC will include the following elements:

- A comparison of the emission factor with those
  - recommended in the Guidelines
  - identified through a literature search (peer reviewed literature and other reports)
  - identified by national source-experts (e.g. industry organizations and researchers)
  - that can be derived from emission data reported from the plants
- An assessment of the representativity of the emission factors used for national circumstances (particularly when they are based on default emission factors and international research)
- A quantification of the uncertainty (addressing statistical and non-statistical errors)
- An assessment of the content of documentation, including technical documentation
- An assessment of the availability (archiving) of documentation, including technical documentation
- An assessment of changes in emission factors over time due to changes in technology and/or management

Activity data

The category specific QC will be performed by the Climate and Pollution Agency, Statistics Norway and The Forest and Landscape Institute for the data collected by each institution. Some activity data are originally collected by another institution. In this situation the Climate and Pollution Agency, Statistics Norway or The Forest and Landscape Institute (as appropriate) are responsible for assessing the QC applied on these data and perform their own additional QC on aggregate data.

The activity data QC will include the following elements:

- An evaluation and documentation of the QC routines applied at the survey level (at the point of interview/field work and the data checking/processing level)
- An evaluation of the techniques used to obtain annual data (if applicable)
- An assessment of sampling and representativity, including an evaluation of possible bias for application of the data in inventories (for LULUCF area data and for statistical survey data)
- An assessment of the classification of land areas and assumptions needed to apply data from the national forest inventory and area frame land resource surveys (NFI)

- An assessment of the completeness compared to the category definitions of the IPCC guidelines and good practice guidance for LULUCF and the reporting requirements
- A review and assessment of alternative data sources
- A comparison with independent data sources (if possible)
- A quantification of uncertainties (including statistical and non-statistical errors)

Documentation

For each category, a review and update of the documentation will be performed if needed. The requirements for documentation will be highest for key categories. The QC should include

- an assessment of whether the documentation is sufficient to understand the data, methods and assumptions behind an estimate of emissions or removals
- a recording of changes that have been made as a response to the QC checks
- a description of consequences for the time-series of changes in data or methods
- writing and archiving of additional technical documentation as needed (in English if practical or in Norwegian) to enable the replicability of estimates for a reviewer

3.2.3 CRF tables

Through use of the new UNFCCC software for reporting it is anticipated that data from the emission model can be transferred directly to the CRF, and this will reduce the need for dedicated QA/QC checks. Statistics Norway will develop a separate dataset for notation keys. QC consistency checks are built in the new CRF. Statistics Norway will be responsible for additional checks on an annual basis:

- Check of total emissions against those of the emission model
- Check of sectoral totals against those of the emission model
- Check of notable changes from previous submissions for individual categories
- Check of correct use of notation keys

LULUCF data needs to be entered manually to the CRF. The Norwegian Forest and Landscape Institute is responsible for checking all LULUCF entries with data from its database. Statistics Norway is responsible for a consistency check of the LULUCF data compared to the rest of the inventory.

The Climate and Pollution Agency is responsible for a final check of the CRF for completeness and for checking that Statistics Norway and The Norwegian Forest and Landscape Institute have completed the QC checks they are responsible for. The Climate and Pollution Agency is responsible for making the final approval of the CRF tables.

3.2.4 NIR

The Climate and Pollution Agency is responsible for the annual QC of the NIR. This includes checking that

- All figures on emissions and removals (including the key category analysis) in tables and text are consistent with those reported in the CRF
- Trends in emissions and removals are explained
- All methodological changes are explained
- All recalculations are explained and the effect on time-series consistency reported
- The textual description reflects methodologies used
- Responses to the review report are reflected
- Priorities for improvements are described in line with decisions
- All other information is correct (including QA/QC plan, uncertainties and completeness)

3.2.5 Timeliness

The Climate and Pollution Agency, Statistics Norway and The Norwegian Forest and Landscape Institute have agreed on a timetable to enable the Climate and Pollution Agency to report to UNFCCC by April 15 (see Table 1). It is the responsibility of the Climate and Pollution Agency, Statistics Norway and The Forest and Landscape Institute to make this timetable known in their respective institutions to ensure that internal deadlines for data collection and processing in each institution as far as possible suits the emission inventory production cycle.

3.2.6 QC documentation

The members of the inventory team working with individual sectors or parts of a sector write a QC report to the person at each institution in charge of QC, who then reports to the person in charge of QC for the national system. The reports include a description of the general and source-specific tests that have been conducted, and whether these have or will be used to correct any data. The list of general and category-specific QC tests described above will be used as a checklist for the QC reports.

3.3 QA procedures

According to the IPCC Good Practice Guidance (IPCC, 2004), "*good practice for QA procedures requires an objective review to assess the quality of the inventory, and also to identify areas where improvements could be made*". QA involves reviewers that have not been involved in preparing the inventory. They should be independent from the institutions involved in the national system, or not closely involved in the inventory compilation. We distinguish between QA of input data and of the entire inventory.

3.3.1 Statistical data and emissions reported from plants

Emissions reported from plants

Emissions reported from industrial sites are always checked by the Climate and Pollution Agency (see section 3.3.2) by the administrative department in charge of

evaluating emission permits. The Climate and Pollution Agency has a separate department of Control and International Affairs, which consists of three sections for product and industrial control working independently from the sections evaluating emissions permits. They inspect and monitor industrial sites, including underlying documentation for the emission estimates.

There are two types of controls, one is a *frequency-based control* and the other is a *specific campaign control.*

The frequency-based control is as shown in Table 3.

Table 3. Independent control frequency of industrial plants

Control class[1]	Inspection	Audit	Self-reporting
1	Every four years	Every four years	Annually
2	Every six years	Every six years	Annually
3	Every 3-4 years	-	Annually
4	If needed	-	If needed

[1]Industrial sites are divided into four control classes. Those that have the largest potential to generate pollution are included in class 1. Those that are included in class 4 have a relatively limited potential to generate pollution. The potential to generate pollution is determined by the hazard of their emissions and discharges, the quality/sensitivity of the recipient and the use of hazardous chemicals

There are three main methods of determining compliance at industrial sites:

- *Inspections* are normally a one-day unannounced visit at the site. An inspection is a useful method to verify compliance with the specific requirements.
- *Audits* and source testing of emissions: Environmental audits and source testing are used not only to monitor compliance but also to evaluate the environmental management system in the enterprise. These audits are more comprehensive than inspections and are planned well in advance in cooperation with the industrial site.
- *Self-reporting* of data: For enterprises in control class 1, 2 and 3, the permit includes a requirement to establish and maintain a well-defined self-monitoring program. Once a year they must submit an account of their emissions to the Climate and Pollution Agency. This report should include their total emissions, any discharges exceeding the discharge limits or other violations. The reasons for violations must be given together with an explanation of corrective actions taken to avoid recurrence. This self-reported data is often checked during inspections and audits.

An inspection is a one-day on-site control, while an audit may take 3-5 days. The focus of a control/revision may vary. The administrative department in charge of evaluating emission permits can suggest topics for focus of the controls.

Control campaigns take place after a consideration of experiences and results of previous campaigns. Typically such campaigns will be used to check reported emissions.

The Climate and Pollution Agency has several possibilities for sanctions and other enforcement instruments to ensure compliance at industrial sites. They include the requirement to provide information to the authorities, coercive fines, withdrawal of the permit, and reporting violations to the prosecuting authorities.

Particular controls are directed to the plants included in the emission trading system to check that reported emissions are in line with the emission trading regulation (Annex 3). All plants will be controlled once over a period of three years. These controls have focused on the plant's implementation of the reporting requirements. The basis for the reporting, including activity data, emission factors, and uncertainty estimates have been reviewed. So far the controls have aimed at facilitating reporting, and the plants have not been punished for possible weaknesses. These controls will continue, and it is expected that deficiencies will be met with stringent requests for improvements. Future requirements for controls will be consistent with international rules, particularly the rules associated with the EU Emissions Trading System.[14]

For the purpose of the inventory, additional QA is undertaken by the Section for Environmental Economics and Emission Inventories in the Climate and Pollution Agency before the data are sent to Statistics Norway. These QA checks include consideration of time-series consistency and a comparison of emissions per unit produced.

Statistical data

All data collected by institutions not included in the national system undergo a QA performed by the Climate and Pollution Agency or Statistics Norway or The Norwegian Forest and Landscape Institute as appropriate Furthermore, the inventory teams perform a QA of data collected in their institutions in addition to the QC performed by the units responsible for the data collection. For example, Statistics Norway, where possible, compares data on fuel consumption sampled in official statistics to emission data from fuel consumption at plants reported to the Climate and Pollution Agency, and deviations are explained through contact with the plants.

3.3.2 The entire inventory

UNFCCC review

The annual review of the inventory and NIR under the UNFCCC is considered to be part of the QA. This review is performed by a team of experts (sector experts and generalists) from other Parties. Their tasks include examining the data and methods used by Norway and the documentation and concluding whether they are in accordance with current guidelines. The review results in a review report point indicating specific areas where the inventory is in need of improvements.

Expert peer review

The inventory and its documentation will be published annually, and industry associations, relevant research institutions, directorates and environmental

[14] It is expected that Norway will adopt the Directive.

organizations are invited to review and suggest improvements in the inventory. Any results of this review will be used by the cooperating institutions to improve the inventory.

Audits

The Climate and Pollution Agency, Statistics Norway and The Norwegian Forest and Landscape Institute are audited by the Auditor General of Norway. In addition to financial audits, the auditor general also performs performance audits, a systematic analysis of the economy, efficiency and effectiveness of the government administration on the basis of the decisions and intentions of the Norwegian parliament. The Office of the Auditor General uses performance audits to shed light on specific areas within the government administration where there is a risk of noncompliance and/or deficiencies in relation to the resolutions and intentions of the Norwegian parliament. An audit of the national system may be initiated as a part of this.

The usefulness of having a private company conduct an independent audit of the implementation of the national system will be considered at a later stage.

3.4 Implementation of QA/QC procedures

The core institutions of the national system will implement the QA/QC plans by establishing internal procedures. These procedures will assign internal responsibilities for the QA/QC checks suggested in chapter 3.3 and facilitate input to the QA/QC report. Each institution will organize project teams to handle the implementation of the QA/QC plan. The project teams will be informed about the data quality objectives of the national system.

Box 1. The Total Quality Management project of Statistics Norway

In 2001, Statistics Norway started a Total Quality Management project to broaden the quality concept of the national emission inventory (Statistics Norway 2001a). The goal was not just to achieve traditional data quality, but also to take into account the need to meet the deadlines of international reporting of emission data.

For this task a project team was established. The team had representatives from both the users of the emission inventory data and the input data providers, as well as members at different levels of the inventory team. Early in the project, the team made a flow chart of the different processes involved in the inventory work – from receiving all the different input data to international reporting and the publishing of the results in a press release. Based on this, "bottlenecks" (critical process variables) and connected processes were identified. The energy data for the manufacturing industry (as provided by Statistics Norway) was identified as the most critical dataset because it is not only essential for the results but also finished quite late compared with the need for timeliness of inventory data (with respect to deadlines for international reporting). The inventory team must therefore try to involve the key data providers more closely in the inventory preparation process, give them information about the applications and invite them to try to adjust their internal deadlines to better support the essential deadlines for the inventory work.

The project team concluded that the data providers must be more closely involved in the work:

- Data providers must know that their data is important for the quality of the whole inventory. Data providers must know that the Norwegian reporting to the UNFCCC and LRTAP Convention and be delayed if their work is delayed.
- The data providers may be able to change their time limits to be able to deliver the data earlier.
- The inventory team should improve information to the providers about what kind of data they need and at what time they need the data.
- The data providers should be responsible for reporting any delay as soon as possible to the inventory team.

3.5 Plan for improving the data

The inventory may need to be further developed before it can fulfill the data quality objectives. The three institutions will collectively produce plans for improving the data. The plan will be based on the key category analysis, the UNFCCC review, QA/QC activities, new information and other needs, for example needs for better data for the development of emission reduction strategies and regional statistics.

The cooperating institutions produce a plan for improvements of the inventory. This plan may also point out needs that cannot be handled through ordinary inventory projects, but through research projects. The autumn cooperation meeting between the three institutions agree on priorities for the following year.

4 Production of emission data

Details of the methods and framework for the production of the emission inventory are given in the reports “Documentation of the Norwegian system of emission inventories” (Statistics Norway 2009) and “Emissions and removals of greenhouse gases from land use, land-use change and forestry in Norway” (NIJOS, 2005). The (Statistics Norway 2009) is updated annually in conjunction with important methodological changes and used as a basis for the NIR.

Norway has an integrated inventory system for producing inventories of the greenhouse gases included in the Kyoto Protocol and the air pollutants SO_2, NO_x, non-methane volatile organic compounds (NMVOC), ammonia, CO, particulate matter, heavy metals and persistent organic pollutants reported under the LRTAP Convention. The data flow and QA/QC procedures are to a large extent common to all pollutants.

4.1 Assessment of key categories

The key category assessment is made by Statistics Norway using the IPCC Tier 1 and the Tier 2 method, which includes uncertainty estimates. The assessment is updated annually and is made for the level and trend since 1990. Statistics Norway also considers the qualitative criteria for identification of key categories. In accordance with the IPCC good practice guidance for LULUCF (IPCC, 2004) the analysis is made in two parts, one excluding LULUCF emissions and removals and another integrating LULUCF with the rest of the inventory. Due to the large LULUCF sink in Norway, the results of these two parts are quite different.

4.2 Data collection

In the agreements, the three institutions of the national system have defined areas of responsibility for data collection. The current division of responsibility for the most important data is shown in Table 4. The table focuses on data that are updated regularly and not emission factors that are assumed constant over several years. Emission factors are normally collected through dedicated projects. Through the cooperation meetings, the institutions may agree to reallocate responsibilities.

Table 4. Main responsibilities for data collection

	Data	Institution in charge of primary data collection
Climate and Pollution Agency		
	• Emissions from large industrial plants (point sources) (around 70 at present, but some of these do not report GHG emissions)	• Climate and Pollution Agency
	• Emissions from off-shore activities, including drilling activities, fugitive emissions, well-testing oil burning and emission factors for crude oil loading	• The Norwegian Petroleum Directorate and the Climate and Pollution Agency
	• Methane recovery from landfills	• Climate and Pollution Agency
	• Import of HFCs, PFCs and SF_6 by application. Import HFCs, PFCs and SF_6 in products.	• Climate and Pollution Agency (The customs authorities "Toll og avgiftsdirektoratet" in the future)
Statistics Norway		
	• Energy balance/account (energy use by sector and application), energy use in point sources. This statistics is building on a number of primary data sources (surveys and censuses)	• Statistics Norway
	• Production data, import and export	• Statistics Norway
	• Vehicle registrations	• Statistics Norway
	• Transport statistics	• Statistics Norway, Institute for Transport Economics (TØI), Norwegian Road Federation (opplysningsrådet for veitrafikk)
	• Agriculture statistics, including animal population and manure management	• Statistics Norway
	• Fertilizer use and lime application	• Norwegian Food Safety Authority (Mattilsynet), Directorate for Nature Management (Direktoratet for naturforvaltning)
	• Waste disposal and waste characteristics	• Statistics Norway
	• Waste water statistics	• Statistics Norway

Forest and Landscape	• Area statistics from the national forest inventory and national area frame land resource surveys	• Forest and Landscape
	• Parameters needed to estimate changes in biomass stocks from the national forest inventory and national area frame land resource surveys	• Forest and Landscape
	• Area statistics from administrative sources, e.g. agriculture statistics	• Statistics Norway

4.3 Uncertainty calculations

Norway has quantified uncertainties in input data and in total emissions and its trend (Norwegian Pollution Control Authority 1999a; Statistics Norway 2000; Statistics Norway 2001b; Statistics Norway 2009, Appendix D; Statistics Norway 2011). The uncertainties in input data were made in consultation with sector experts, combining expert judgments by source experts, information in the IPCC good practice guidance (IPCC, 2000) with other sources of information. The uncertainties were combined using the IPCC Tier 2 method (bootstrap techniques). The last uncertainty analysis of the total inventory was performed in 2011 on 1990 and 2009 emission data. Uncertainty estimates are also yearly updated for sources when the estimation methods or data sources are being changed.

Uncertainties in the LULUCF sector have been estimated less rigorously.

4.4 Recalculations

In accordance with the IPCC good practice guidance IPCC (2000), Norway routinely evaluates whether recalculations of historical data are needed. Recalculations are made if there have been methodological changes influencing emissions in previous years or changes in data due to correction of errors or changes in preferred data sources.

When data sources are not available for the whole time-series since 1990, one of the proposed methods from the IPCC good practice guidance IPCC (2000) is used to splice data. Normally extrapolations using drivers correlated with emissions or the overlap method is used. Smaller emission sources may be linearly extrapolated (or kept constant). The method is chosen on the basis of available data and suitability of drivers.

Data from the National Forest Inventory are collected over a period of five years. Each year provides a statistically representative coverage of Norwegian forests, but with only 1/5 of the statistical support of the full inventory. Annual reports can be issued based on the annual data, but are expected to fluctuate somewhat. It is therefore proposed to recalculate the estimates using a five year moving average with extrapolation of the last two years.

Estimates based on the national area frame survey of land resources will be calculated using the data available each year. Aerial photographs will be used in order to detect

changes in land use. Weather conditions in Norway are unpredictable and it is known from experience that flight plans usually will be changed somewhat. It is therefore expected that the annual data reported from this survey will fluctuate somewhat from one year to another and that recalculation of reports are required as the data set is replenished with new observations offering stronger statistical support.

4.5 Emission calculations

4.5.1 The main emissions model

The model was developed by Statistics Norway (1992, 1994). It was redesigned in 2003 in order to improve reporting to the UNFCCC and LRTAP, and to improve QA/QC procedures. The model is programmed in SAS system software and is flexible with respect to output, i.e. it can produce tables (input and output) in accordance with different aggregation levels and parameters. Furthermore, it has been designed to fit the availability and aggregation of input data and is flexible with respect to changes. Emission factors can be entered for groups of years.

The model is called "Kuben" ("the Cube"). Several emission sources – e.g. road traffic, air traffic, waste and solvents – are covered by more detailed satellite models. Aggregated results from these side models are used as input to the general model.

The general emission model is based on equation (1).

(1) Emissions (E) = Activity level (A) · Emission Factor (EF)

For emissions from *combustion*, the activity data is based on energy use. In the Norwegian energy accounts, the use of different forms of energy is distributed by industries (economic sectors). In order to calculate emissions to air, energy use must also be allocated to technical sources (e.g. equipment). After energy use has been allocated in this way, the energy accounts may be viewed as a cube in which the three axes are fuels, industries, and sources.

The energy use data are combined with a corresponding matrix of emission factors. In principle, there should be one emission factor for each combination of fuel, industry, source, and pollutant. Thus, the factors may be viewed as a four-dimensional "cube" with pollutants as the additional dimension. However, in a matrix with a cell for each combination, most of the cells would be empty (no consumption). In addition, the same emission factor would apply to many cells. There are about 25 fuels and about 25 technical sources used for energy combustion.

Emissions of some pollutants from major manufacturing plants (point sources) are available from measurements or other plant-specific calculations (collected by the Climate and Pollution Agency). When such measured data are available, the estimated values are replaced by the measured ones:

$$(2) \quad Emissions\ (E) = [\ (A - A_{PS})\ \cdot\ EF] + E_{PS}$$

where A_{PS} and E_{PS} are the activity and the measured emissions at the point sources, respectively. Emissions from activities for which no point source estimate is available (A-A_{PS}) are still estimated with the regular emission factor.

Non-combustion emissions are generally calculated in the same way, by combining appropriate activity data with emission factors. Some emissions are measured directly

and reported to the Climate and Pollution Agency, and some may be obtained from current reports and investigations. The emissions are fitted into the general model using the parameters industry, source, and pollutant. The fuel parameter is not relevant here. The sources for non-combustion emissions and for combustion without energy use are based on EMEP/NFR and UNFCCC/CRF categories, with further subdivisions where more detailed methods are available.

The model uses approximately 130 *industries* (economic sectors). The classification is almost identical to that used in the National Accounts, which is aggregated from the European NACE (rev. 1) classification (Statistics Norway 1994). The large number of sectors is an advantage in dealing with important emissions from manufacturing industries. The disadvantage is an unnecessary disaggregation of sectors with very small emissions. To make the standard sectors more appropriate for calculation of emissions, a few changes have been made, e.g. "Private households" is defined as a sector. Information about the geographical distribution of emissions is useful for modelling and control purposes and constitutes a fifth axis.

4.5.2 The LULUCF model

The Norwegian Forest and Landscape Institute is in charge of estimating emissions and removals from Land use, Land-Use Change and Forestry (LULUCF) for all categories where area statistics are used for activity data. They have developed a calculation system in the form of computer programs that uses R and excel for the implementation of the IPCC good practice guidance for the LULUCF sector. The systems use input data from different sources and create final output datasets. These final datasets include all data needed for the tables in the common reporting format (CRF), both for the Climate Convention and the Kyoto-protocol.

The National Forest Inventory (NFI) database contains data on areas for all land uses and land-use conversions as well as carbon stocks in living biomass. The NFI is used to establish total area of forest, cropland, wetlands, settlements and other land and land-use transitions between these. The data from the NFI is complemented with other data (e.g. horticulture, tillage practice, amount of fertilizer used, liming and drainage of forest soil, liming of lakes and forest fires) collected by Statistics Norway, Norwegian Agricultural Authority, Food Safety Authority, The Norwegian Directorate for Nature Management and The Directorate for Civil Protection and Emergency Planning.

The sampling design of the NFI is based on a systematic grid of geo-referenced sample plots covering the entire country. The NFI utilizes a 5-year cycle based on a re-sampling method of the permanent plots. Up to 2010 the estimates were based on detailed information from sample plots below the coniferous limit. To confirm the land use, the extent of the area of forest and other wooded land at higher altitudes and in Finnmark County, the NFI conducted a complete forest inventory during 2005–2010 for these areas. All areas were for the first time included in the estimates for the LULUCF sector in the 2012 submission. The land-use change areas above the coniferous limit and in Finnmark County, have been recalculated in the 2013 submission, due to the inclusion of informationfrom NFI, maps, old and new aeriel photos, that have been used to improve the estimates back to 1990.

The calculations of biomass and carbon stock in forest are based on single tree measurements and stand attributes from the permanent sample plots on forest and

other wooded land under the coniferous forest limit. Biomass is calculated using single tree biomass equations developed in Sweden for Norway spruce, Scots pine and birch (Marklund 1987, 1988 and Petersson and Stähl 2006). These equations provide biomass estimates for various tree biomass components: stem, bark, living branches, dead branches and needles, stumps and roots.

These components are used to calculate above- and belowground biomass. The biomass of trees below and above coniferous limit and with diameter less than 50 mm (small trees) at 1.3 meter height (DBH) , trees from higher altitudes and trees in Finnmark County are included in the estimates for the whole time-series. The standing volume of these biomass pools constitute 7 percent of the stem volume of standing trees with DBH equal to or larger than 50 mm from the area below the coniferous limit. Hence, 7 percent of the net change of CO_2 removals of living trees below the coniferous limit is included in the estimates. It is assumed that these proportions have remained constant over the last twenty years.

The dynamic soil model Yasso07 was used to calculate changes in carbon stock in dead organic matter and in soil for forest land remaining forest land. (Tuomi et al., 2011; Tuomi et al., 2009). Simulations were made for individual NFI plots for the entire time-series. The Yasso07 model provides an aggregated estimate of carbon stock change for the total of litter, dead wood and soil organic matter. The system is still under development. All data used as input to the models is provided by the Norwegian Forest and Landscape Institute. Data used for estimation of C emissions from cropland, grassland, wetlands, and settlements are derived from Statistics Norway, Norwegian Meteorological Institute and Bioforsk research institute.

5 Handling of data

5.1 Archiving

The guidelines for the national system specify the requirements for archiving. Archiving shall include:

- Disaggregated emission factors
- Activity data
- Documentation of data collection, assumption and aggregation
- Internal documentation on QA/QC procedures
- External and internal reviews
- Documentation on annual key sources
- Planned inventory improvements

All three core institutions are responsible for archiving the data they collect and the estimates they calculate with associated methodology documentation and internal documentation on QA/QC. The Guidelines for National Systems, however, state that "Annex I Parties should make the archived information accessible by compiling it at a single location.

Due to the differences in the character of data collected, Norway has chosen to keep archiving systems in the three core institutions, which means that not all information is archived at a single location, see Table 5 for an overview. These archiving systems are, however, consistent. Although the data are archived separately, all can be accessed efficiently during a review. However, data archived at Statistics Norway are subject to rules of confidentiality, and this must be taken into consideration during reviews. In addition, the Climate and Pollution Agency has started to build up a physical and electronic library with the most important methodology reports. Based on the reference list of the NIR, the Climate and Pollution Agency has started to collect physical copies of the most important methodology reports. The reports are placed in one of the inventory compilers' office. Electronic copies of the most important methodology reports are also collected. This is systemized in a catalogue in the agency's achieving system (ePhorte) and URLs are also included if available. Some of the older methodology reports have been scanned in order to make them more easily available. The archiving systems in all three institutions will be developed for the implementation of the national system, see Annex 7.

The common rules for archiving of data are the following:

- Data and information are archived for each submission year
- Data and information are archived in a single location within each institution (this may imply double archiving)
- Archiving for a submission year includes
    - All input data
    - All estimated emissions
    - All partly filled-in or final CRF
    - All technical documentation
    - Recalculations of previous estimates, if any
    - The NIR (where relevant)
- The file structure is documented
- The platform at which the data and information is archived undergoes a daily backup and the backup is securely saved

Confidentiality could be an issue for the data collected by Statistics Norway when there are few entities reporting for a source-category. However, confidential data used in the inventory are now almost entirely replaced by non-confidential data collected by the Climate and Pollution Agency. Consequently, confidential data are not expected to cause any difficulty during a review, but must be taken into consideration and evaluated separately in each case.

Table 5. Responsibilities for archiving information. Capital X indicates archiving also of datasets sent from the other institutions.

	Climate and Pollution Agency	Statistics Norway	Forest and Landscape	Comments
Disaggregated emission factors	x	X	x	All are archived by Statistics Norway
Activity data	x	X	x	
Emission data collected from large plants	X	X		Statistics Norway does not collect these data, but will archive them as part of their emission model
Documentation of data collection, assumption and aggregation	X	x	x	Climate and Pollution Agency will build up a library of all important reports (including background reports)
Internal documentation on QA/QC procedures	x	x	x	
External and internal reviews	X	x	x	
Documentation on annual key categories		x		
Planned inventory improvements	X			
Estimated emissions (model output)		x		
CRF	X	(x)		Statistics Norway will archive a copy
NIR	X			
Recalculations	X	X	x	

5.2 Access to archived data during a review

By systematic archiving as described above, all information can be made available to a review team in the course of a few hours. It is expected that the most relevant documentation will be available in the central archive of the Climate and Pollution Agency. Comprehensive documentations for LULUCF and other emission sources are available in English (Hoem (ed.), 2005; NIJOS, 2005). Additional technical documentation may be in Norwegian only, as will the emission reports from the plants. The Climate and Pollution Agency, Statistics Norway and The Forest and Landscape Institute are responsible for having competent personnel on duty during a review to access data if requested.

5.3 Allocation of responsibilities during a review

The Climate and Pollution Agency has the main responsibility for coordinating the review. Statistics Norway and The Norwegian Forest and Landscape Institute will be allocated specific responsibilities during the review. The Climate and Pollution Agency is responsible for informing Statistics Norway, The Forest and Landscape

Institute and the Climate and Pollution Agency experts about the timing of the review at least two months before it takes place to ensure their availability.

Table 6. Main responsibilities during a review (lead in capital)

	Climate and Pollution Agency	Statistics Norway	Forest and Landscape
Preparation and coordination	x		
General, national system and cross-cutting issues	X	X	
Energy	x	X	
Industrial processes	X	x	
Agriculture		X	
LULUCF		x	X
Waste	x	X	
Direct communication with UNFCCC Secretariat	x		

6 References

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7 Annexes

7.1 Annex 1. The Norwegian Air Pollution Act (Chapter 7)

Chapter 7. Inspection and control measures relating to pollution and waste

§ 48. The responsibilities of the pollution control authority

The pollution control authority shall be responsible for monitoring the general pollution situation and pollution from individual sources. The pollution control authority shall also be responsible for monitoring waste management.

The pollution control authority shall by means of advice, guidance and information seek to counteract pollution and waste problems and shall ensure compliance with the provisions of this Act and of decisions made pursuant thereto.

§ 49. Duty to provide information

On orders from the pollution control authority, any person that possesses, does, or initiates anything that may generate pollution or result in waste problems has a duty, notwithstanding any duty of secrecy, to provide the pollution control authority or other public bodies with any information necessary to enable them to carry out their tasks pursuant to this Act. If special reasons so indicate, the pollution control authority may require that information shall be provided by any person who works for the person that is subject to the duty to provide information pursuant to the first sentence.

Information as mentioned in the first paragraph may also be required from other public authorities, notwithstanding any duty of secrecy that otherwise applies.

Decisions made pursuant to the first or second paragraphs may be made by regulations or by individual decision.

§ 50. Right of inspection

The pollution control authority shall be given unimpeded access to property where pollution may occur or has occurred, or which is or may be exposed to pollution, if this is necessary for the exercise of its duties pursuant to this Act. The same applies to any enterprise that has resulted or may result in waste problems.

The pollution control authority may require documents and other material that may be of importance for the exercise of its duties pursuant to the Act to be submitted for its inspection.

Before inspection of an enterprise, the pollution control authority shall contact representatives of the management.

§ 51. Orders to carry out investigations

The pollution control authority may order any person that possesses, does, or initiates anything that results in or that there is reason to believe may result in pollution to arrange or pay for any investigations or similar measures that may reasonably be required in order to:

a. determine whether and to what extent the activity results in or may result in pollution,
b. ascertain the cause of or impact of pollution that has occurred,
c. ascertain how the pollution is to be combated.

The provision of the first paragraph applies correspondingly to any activity that result in or may result in waste problems.

Orders pursuant to the first and second paragraphs may be laid down by regulations or in individual cases.

§ 52. Approval of laboratories and analytical methods

The pollution control authority may by regulations or individual decision lay down that investigations and analyses carried out in accordance with decisions made pursuant to this Act shall be carried out in the way decided by the pollution control authority or must be carried out by a person approved by the pollution control authority.

7.2 Annex 2. The Greenhouse Gas Emission Trading Act (chapter 4)

Chapter 4. Reporting and control

§ 16. (reporting)

An operator shall by 1 March each year report to the pollution control authorities on CO_2 emissions during the previous calendar year to which the duty to surrender allowances applies.

The King may by regulations lay down further provisions on reporting, including the information to be provided and how emissions are to be calculated or measured.

§ 17. (control by the pollution control authorities)

The pollution control authorities will control and verify the reports on CO_2 emissions submitted by each operator pursuant to section 16.

In special cases, the pollution control authorities may issue an order for the emissions report from an operator to be verified by an independent third party before it is submitted. The King may by regulations lay down further provisions on requirements relating to and accreditation of verification bodies, including how verification reports are to be drawn up and their contents.

The King may by regulations prescribe that the costs incurred by the pollution control authorities in verifying emissions reports pursuant to this section are to be met by the operators.

§ 18. (requirement to provide information or make investigations)

The pollution control authority may require operators to provide information or carry out or pay for investigations or other measures it is reasonable to require to determine whether it is necessary to alter the provisions on reporting laid down pursuant to section 16.

7.3 Annex 3. Regulation on Greenhouse Gas Emission Trading (The Emission Trading Act)

Regulations relating to greenhouse gas emissions trading (the Emission Trading Regulations) were adopted on 23 December 2004 and entered into force on 1 January 2005. Chapter 2 of the Emission Trading Regulations contains general and activity-specific provisions concerning monitoring and reporting of emissions. Annex 1 of the domestic regulations contains detailed activity-specific rules for calculating and measuring emissions. Annex 2 is a non-exhaustive list of materials that are considered to be biomass. The provisions are based on the guidelines for monitoring and reporting emissions set out in Decision 2004/156/EC (the MRG), and adapted to Norwegian conditions.

The monitoring methodology to be used by operators to whom the Norwegian trading scheme applies is all specified in these regulations, and not in the permit for each installation.

Section 2-1 of the regulations states that emissions covered by the trading scheme shall be reported by 1 March the following year in accordance with the provisions set out in Chapter 2 and Annex 1 of the regulations.

Section 2-2 states that calculations and measurements shall be made in accordance with the provisions set out in Annex 1. If it is obvious that use of a different monitoring methodology will give more accurate emission figures, the operator shall use that methodology. This provision refers to those cases where use of an alternative monitoring methodology described in MRG would provide more accurate emission figures.

Section 2-3 contains general requirements for reports from operators. These requirements include:

- a description of sources of emissions for each activity carried out at the installation, together with emission figures for each source and total emissions
- a description of how activity data (fuels, input material, production output) have been gathered and assessed. If a mass balance is applied, the operator shall report the mass flow, carbon and energy content for each fuel and material stream into and out of the installation and their respective stocks
- a description of how emission factors have been determined
- information concerning any temporal or permanent changes in monitoring methodology, and grounds for such changes
- Any other changes in the installation during the reporting period that may be relevant for the emission report.
- amounts of biomass combusted (TJ) or employed in processes (t)
- amounts of fossil fuels subject to the CO_2 tax (e.g. mineral oil and petrol) combusted and employed in processes (t), and calculated CO_2 emission figures from these activities.

- amounts of hazardous waste and municipal waste combusted (t)
- amounts of CO_2 or CO transferred from the installation (t)
- copies of relevant quality assurance and control procedures established so that emissions can be monitored and reported in accordance with the regulations.

If the emissions have been determined using a continuous measurement system, the operator must report which method has been used. If a standardized measurement method has not been used, the operator must give a detailed description of the method. The operator must report the level of uncertainty associated with the measurements, and must be able to justify that use of a measurement-based methodology gives higher accuracy than the relevant calculation-based methodology.

Sections 2-4 to 2-9 contain activity-specific provisions (combustion installations above 20 MW, refineries, coke ovens, steel production, cement plants and other mineral-based production) relating to data that the operator must submit in the report. Annex 1 gives detailed rules for calculating emissions from each of the activities set out in section 2-4 to 2-9. Annex 1 also contains information on sources that are to be included in the calculation and formulae to be used for calculating emissions from each of the activities. The rules set out in Annex 1 are unambiguous and predictable for each activity. In principal, all installations engaged in the same activity must use the same methodology. The activity-specific methodologies are in principle consistent with the highest tiers as set out in Annexes II to X in MRG. Process emissions from pulp and paper installations are not included by the Norwegian trading scheme because they are subject to the CO_2 tax.

Annex 1 contains reference emission factors (t CO_2/t) and net calorific value (TJ/kt) for various fossil fuel types.

Emission reports must be submitted in a standardized electronic format directly to the Pollution Control Authority by 1 March each year. The Authority may require third-party verification of emission reports from installations with multiple and complex processes. In addition to technical data on emissions, a report must include identification data for the installation, such as its name, address and identification number.

An operator's right to transfer allowances will be suspended if he has not reported in accordance with the rules by the time limit (Greenhouse Gas Emission Trading Act § 19). The same applies if the content of the report is not satisfactory or it contains errors. In such cases, the Pollution Control Authority will in those cases give the operator a quick response indicating which parts of the report must be improved. At the same time the operator will be given notice of suspension if the report is not corrected in accordance with the rules within a specified deadline. The deadline will be set so that the Authority can assess whether the report has been corrected satisfactorily in line with the regulations before it has to decide whether or not to suspend the operator with effect from 1 April. The operator will be informed that suspension will be upheld until a complete emission report in line with the regulations has been submitted.

The Pollution Control Authority may in addition impose a coercive fine in the event of contravention of the duty to report on emissions (see Greenhouse Gas Emission Trading Act § 20). If an operator does not report in accordance with the rules despite the possibility of being suspended from the right to transfer allowances, it is to be hoped that a satisfactory report will be received shortly after suspension is

effectuated. If not, the Pollution Control Authority may impose coercive fines which will continue to be effective for as long as the unlawful situation persists.

Before determining whether to impose an excess emissions fine in accordance with the Greenhouse Gas Emission Trading Act § 21, the Pollution Control Authority must determine an operator's emissions and compare the result with the allowances surrendered by the same operator.. If an operator has not reported in accordance with the rules despite suspension and the imposition of a coercive fine, the Pollution Control Authority must estimate the emissions based on the rules that the operator should have followed in the first place. In such cases, the Authority will probably have to carry out an on-site inspection to obtain the necessary information.

It follows from the Greenhouse Emission Trading Act § 22 that any person who wilfully or through negligence contravenes the provisions on the duty to report emissions is liable to fines or to a term of imprisonment not exceeding three months, or both. Such a breach could also be punishable in accordance with the provisions of the Penal Code relating to false testimony (see the general civil penal code § 166, first paragraph).

7.4 Annex 4 The Statistics Act (Chapter 2 and 3)

Chapter 2. Official statistics

§ 2-1. Decisions concerning the production of official statistics
Decisions concerning the production of official statistics shall be taken by the King[l].
[1] Ministry of Finance pursuant to Royal Decree No. 387 of 16 June l989. Delegated to Statistics Norway pursuant to Regulations of 13 February 1990 No. 1228.

§ 2-2. Obligation to provide information

> (1) The King[1] may by regulation or resolution impose upon any person an obligation to provide the information which is necessary for the production of official statistics in so far as any legally prescribed obligation of secrecy is no obstacle thereto.
> [1] Ministry of Finance pursuant to Royal Decree No. 387 of 16 June 1989. Delegated to Statistics Norway pursuant to Regulations of 13 February 1990 No. 1228.
>
> (2) A deadline may be set for the provision of information and stipulations may be made regarding the form in which the information shall be given. The obligation to provide information is breached when the information required is not given before the expiry of the deadline.

§ 2-3[1]). Compulsory fines
The body which has laid down the obligation to provide information may impose compulsory fines payable to the state upon such person as breaches this obligation. The imposition of compulsory fines shall be grounds for enforcing payment. Such compulsory fines may be collected by distraint. In special cases compulsory fines that have been incurred may be waived wholly or in part. The King[2] may issue more detailed provisions concerning such compulsory fines.

[1] Amended by Act No. 86 of 26 June 1992 (effective as of 1 January 1993 pursuant to Proposition No. 765 of 23 October 1992), and by Act No. 4 of 18 March 1994 (effective immediately pursuant to Proposition No. 217 of

18 March 1994, and retroactive for compulsory fines fallen due prior to its entry into force.)
[2]Ministry of Finance pursuant to Royal Decree No. 387 of 16 June 1989.

§ 2-4. Obligation of secrecy

(1) Any person performing work or service for a body which prepares or produces official statistics has a duty to prevent unauthorised persons from gaining access to or knowledge of whatever information he or she obtains concerning personal matters, administrative or business matters, or of technical appliances and methods used during the preparation or production of statistics. The obligation of secrecy applies only to such information as is collected for the purpose of producing official statistics.

(2) The obligation of secrecy also applies after the person concerned has completed the work or service. Furthermore, the person concerned may not use such information as is mentioned in this section in his or her own business or in work or in the service of others.

(3) Sections 13 to 13 e of the Public Administration Act do not apply.

§ 2-5. The use of information

(1) Information collected in accordance with any prescribed obligation to provide information, or which is given voluntarily, may only be used for the production of official statistics or for such other use as is approved by the Data Inspectorate and is not detrimental to the security of the realm. If information is handed over, the obligation of secrecy pursuant to § 2-4 shall also apply to the recipient of the information. When particular grounds so indicate, the Data Inspectorate may nevertheless make exceptions to such obligation of secrecy for certain types of information.

(2) Any agency which hands over such information may stipulate conditions *inter alia* concerning the use of the information and who shall be responsible for the information and have access thereto, concerning the storage and return of borrowed material, the destruction of copies, etc.

§ 2-6. The publication of information

Information collected in accordance with any prescribed obligation to provide information, or which is given voluntarily, shall under no circumstances be published in such a way that it may be traced back to the supplier of any data or to any other identifiable individual to the detriment of the person concerned, or to the unreasonable detriment of the latter if the supplier of the data is a company with limited liability, a limited partnership or other association, foundation, public body or.undertaking.
[1] Ammended by Act No. 45 of 20 June 2003

§ 2-7. Cessation of the obligation of secrecy

The obligation of secrecy pursuant to this Act with respect to information concerning personal matters shall cease after 100 years. The obligation of secrecy pursuant to this

Act with respect to information concerning management and business matters and technical appliances and methods shall cease after 60 years.

Chapter 3. The duties and activities of Statistics Norway

§ 3-1. The duties of Statistics Norway

Statistics Norway is the central body for production and dissemination of official statistics and bears the main responsibility for ensuring that the object of this Act pursuant to §1-1 is fulfilled. With respect thereto, Statistics Norway shall:

a) identify and place in order of priority the needs for official statistics

b) coordinate comprehensive statistics which are produced by administrative agencies,

c) develop statistical methods and apply statistics to analysis and research,

d) provide information for statistical use for research purposes and for public planning within the framework of § 2-5 of this Act,

e) bear the main responsibility for international statistical cooperation.

§ 3-2. Administrative data-processing systems

(1) Statistics Norway shall have the right to use administrative data-processing systems in the state administration and in nationwide municipal organisations as the basis for official statistics.

(2) When state bodies or nationwide municipal organizations are to establish or modify a major administrative data-processing system, notice thereof shall be sent in advance to Statistics Norway. Statistics Norway may seek additional information. Statistics Norway may also put forward proposals concerning the manner in which data-processing systems should be designed in order to safeguard consideration for statistics.

(3) The King[1] may issue more detailed provisions concerning the practice of the rules in subsections 1 and 2.

[1] Ministry of Finance pursuant to Royal Decree No. 387 of 16 June 1989.

§ 3-3. Coordination of statistics

(1) When an administrative body is to carry out major statistical investigations, notice thereof shall be sent in advance to Statistics Norway. Statistics Norway may seek additional information. Statistics Norway may forward proposals concerning the manner in which information shall be sought and the manner in which statistics shall be produced in order to safeguard consideration for statistics and coordination.

(2) The King[1] may determine that public research institutes shall be considered to be administrative bodies pursuant to the provisions of this

section.
[1] Ministry of Finance pursuant to Royal Decree No. 387 of 16 June 1989.

7.5 Annex 5. Key data providers

Data providers and sources for the emission inventory ranked in accordance with the importance.

	Very important	Important	Less important
1. Data from Statistics Norway			
• Energy statistics	X		
• Consumer surveys			X
• Living condition survey			X
• Foreign trade statistics			X
• Production statistics			X
• Petroleum statistics	X		
• Agriculture statistics		X	
• Waste statistics		X	
• Waste water statistics			X
• Vehicle registry		X	
• Transport statistics		X	
2. Other institutions			
• The Norwegian Forest and Landscape Institute	X		
• Climate and Pollution Agency	X		
Forurensning	X		
Environmental Web (including data from the Norwegian Petroleum Directorate)	X		
• Norwegian Petroleum Industry Association (NP, norsk petroleumsinstitutt)			X
• Norwegian Petroleum Directorate (Oljedirektoratet)		X	
• Institute of Transport Economics (TØI)			X
• Norwegian Road Federation (Opplysningsrådet for veitrafikk)		X	
• Norwegian Food Safety Authority (Mattilsynet)			X
• The Directorate for Civil Protection and Emergency Planning (DBS)		X	

Until 2012 the emission inventory group at Statistics Norway was part of the division for environmental statistics. In January 2012 this division was split and the emission inventory group was merged with the division for energy statistics. The purpose of this reorganisation was to increase the consistency between the energy statistics and the emission inventories and improve the quality of both.

7.6 Annex 6. QC of activity data – existing routines

7.6.1 Statistics Norway

Documentation of the statistics and routines is available on web (www.ssb.no/en/ (for each statistics click at “about the index”)). An example from the energy statistics is

given below. As a part of the statistical production reported data are checked and the primary data providers are contacted for explanations/revisions if needed.

Example: Energy use in the manufacturing sector

The purpose of the statistics is to give information about energy use in mining and manufacturing. Since the 70s the energy use data are collected as a part of the structural business statistics for manufacturing. From the reference year 1998 the energy use data are collected in a single survey, as a part of an ongoing project between Statistics Norway and the Norwegian Water Resources and Energy Directorate (Enova SF from 2003). The purpose of this is to improve the quality of the energy use information and to develop and produce some new statistics products.

Population
From the reference year 1998 the statistics cover all existing local kind of activity units within mining and manufacturing, which means division 10, 12-37 in the Norwegian Standard Industrial Classification. Statistics Norway collects data for a sample. For de other units the energy use data are estimated. The estimation is based on turnover and information from the sample. There are about 25000 units in the population. Until the reference year 1997 enterprises with individual proprietorship where the owner is working alone (one-man-enterprise), and other local kind of activity units with employment less than half a man-year worked, are not included. The change in the population from the reference year 1998 leads to a break in the statistics.

Data sources
Data of energy use are collected from a sample of local units in manufacturing, mining and quarrying. Turnover data from the short-term turnover statistics (by preliminary figures) and energy costs from the structural data for the manufacturing sector (by final figures) are used by estimating energy use data for units outside the sample. Information on activity codes, addresses and other information are also collected from the Central Register of Establishments and Enterprises of Statistics Norway.

Sampling
The survey has a sample of 3 200 local kind of activity units. The sample consists of the biggest units in each subgroup, chosen by number of employees in each subgroup, and some small and medium sized units. Each industry is represented with as much units as possible. Small units are chosen randomly from a stratified sample. The units in the sample cover about 96 per cent of the total energy use and about 92 per cent of the total energy costs in the mining and manufacturing sector.

Collection of data
The survey is based on questionnaires that are sent out in January the year after the reference year. It is possible to choose between paper forms and electronic forms. The Statistics Act is used, and the units are required to respond. The deadline is in February. There are three reminders. Units that have not responded after the third reminder have to pay a fine. Even if the units pay the fine, they still have to respond.

Control and revision
When we receive the data we first have a consistence check against the previous year to identify serious errors. If we detect serious error we correct the data. Afterwards we are doing a more intimate control of the units with the largest energy consume. The units are classified after this criterion:
Group 1: Energy use > 50 GWh (120 units in 2004)
Group 2: 10 GWh < energy use < 50 GWh (280 units in 2004)

Group 3: Energy use > 5 GWh or/else energy cost. > 1 mil. NOK (600 units)

Group 4: Energy use < 5 GWh or/else energy cost. < 1 mil. NOK (2 200 units)

The local kind of activity units in group 1 have highest priority and will be controlled first. Then we continue with the units in group 2 and 3. Here we have a more intimate consistence check against the previous year and against energy costs in the Central Register of Establishments and Enterprises. If we detect errors in the data we contact the local kind of activity units. At the end we have a consistence check of total energy use and costs in each industry against the previous year.

Estimation
Turnover data from the short-term turnover statistics (by preliminary figures) and energy costs from the structural data for the manufacturing sector (by final figures) are used by estimating energy use data for units outside the sample.
Frequency and timeliness

Yearly
Preliminary figures are published within 6 months after the end of the reference year.
Final figures are published within 18 months after the end of the reference year.

Legal authority
The Statistics Act §§2-2 and 2-3

7.6.2 The Climate and Pollution Agency

Emission data reported from the plants to the Climate and Pollution Agency are entered into the database Forurensning and the information is forwarded to an officer in charge. The officer in charge will check the following:

- That the data in Forurensning are registered as reported from the plants and appropriate corrections are made
- The methodology that was used for estimating emissions
- Emission in comparison to the emission level reported for the previous year. Emissions are displayed graphically. In the case of large deviations the plant is contacted to provide an explanation.
- Emission relative to the production level. In the case of large variations in this ratio the plant is contacted to provide an explanation.
- The emissions seen in relation to other factors, for example changes in production technologies, control technologies or fuels

The Section for Environmental Economics and Emission Inventories are performing additional checks of data before they are sent Statistics Norway, including assessment of time-series consistency and consistency of data reported from plants using comparable technologies.

7.6.3 The Norwegian Forest and Landscape Institute

Survey level

The Norwegian National Forest Inventory has long traditions, and the attributes assessed or measured in the field are subject to frequent revisions, while at the same time it will try to preserve the long time series of key attributes. The main objectives of the NFI are to provide updated forest information to national forest administrations, to be able to report adequately to international forest resources assessments and to provide data for special studies.

Prior to every field season, all field workers will be gathered for one week of briefing of the inventory work. New attributes or altered definitions of attributes will especially be emphasized. The course includes practical training and exercises, under which the assessments and measurements made by each of the fieldworkers will be compared and discussed in plenary.

During the field season, each team will usually be visited by a representative from the head office. The supervisor will join the team on some sample plots in the field, giving an opportunity to discuss possible problems and misunderstandings with regard to classifications and measurements. Normally a check assessment will also be performed, i.e. a subset of the sample plots will be measured a second time by an independent control team. Normally the proportion of plots selected for checking constitutes about 5%. The results from the check assessment will not be used to replace or adjust the original data, but only to assess data quality, detect misunderstandings and incorrect working techniques. Thus, it may lead to improvement of field instructions.

Data is being entered directly into a handheld data logger during the inventory work. A number of consistency checks has been built into this data logger, e.g. to ensure that the correct attributes will be assessed under the current area class. For inventory on permanent sample plots, data from the previous inventory cycle will be stored in the data logger and a warning will appear if the data is not in accordance with what has been assessed before. That also includes single tree data where current diameter and tree height will be checked against the one measured 5 years earlier, in order to detect an unlikely increment rate or confusion with identifying trees. Every week the data are transferred to the head office via e-mail. Further testing for correspondence between different attributes will also be carried out, and detected errors or inconsistencies will be returned to the field crew for clarification.

Data processing

After calculation of volume and annual increment of each sampled tree, the estimates will be aggregated to each sample plot, after which expansion factors will be used to produce results for each geographical region and for the whole country. One sample plot will generally represent an area close to 900 ha. After having made the appropriate summaries, the results will be compared with corresponding data from last inventory and the entire time series of data.

7.7 Annex 7 Archiving – development of routines

7.7.1 Statistics Norway

Archiving of the emission inventory in Statistics Norway takes place at several levels:

1) The inventory is a part of Statistics Norway's central data archiving system. All input data to and results from the general emission model from every publication cycle are stored and documented in this system. Archiving is made after each inventory calculation has been finalised.

2) Input data received as spreadsheets, mail, etc, are stored in folders for every publication cycle. These folders also include preliminary calculations before data are entered into the general emission model.

3) Several input data are used in preliminary calculations before entering into the general Norwegian emission inventory model. This includes satellite models such as road traffic and waste, as well as a number of simpler calculations that do not fit into the framework of the general model. The preliminary calculations are not included in the central archiving system, which is not suited for such a diverse collection of data. For some satellite models there is an established archiving routine where all input data and results from every calculation cycle are stored.

4) During improvement projects, adaptation of activity data or calculations of emission factors are often performed. Examples are emission factors for flaring and air traffic. These improvement projects are not archived as part of the annual folder system, but are stored in separate folders. They are not overwritten when new methodologies, emission factors or activity data are implemented.

Statistics Norway will improve its archiving system in line with the requirements for the national system. This will include improved archiving of input and output from side models (satellite models). These will be archived in one place and the storage of revised versions due to recalculations will be improved as will the documentation of recalculations.

Recalculations are documented for internal use. This document will receive increased status and its accessibility will be improved.

7.7.2 The Climate and Pollution Agency

Emissions from large industrial plants

Reports with emission data and QA control from large industrial plants are sent to the Climate and Pollution Agency and archived in Ephorte. Ephorte is an electronic recordkeeping tool that meets the specifications set by the Noark Standard. The Noark Standard is a specification of functional requirements for electronic recordkeeping systems used in public administration in Norway and has been approved by the Norwegian National Archives. These data reported from the plants are then stored in the Forurensning database[15]. All written correspondence between the plants and the Climate and Pollution Agency is archived in Ephorte. If a plant submits additional information as a result of the QA/QC, this information will also be archived in Ephorte and Forurensning will be corrected accordingly. The Forurensning database does currently not have the functionality to store the original emission data if

[15] The Forurensning database replaced the previous database INKOSYS in 2006. All data in INKOSYS is transferred to Forurensning. .

previously reported data are corrected, but this functionality may be developed. After QA/QC described in 2.3.2, the data (with supplementary notes) for the large industrial plants are stored and archived in a designated file on the Climate and Pollution Agency's server, before being sent to Statistics Norway.

Emissions from off-shore activities

Emission data from off-shore activities are archived in Environmental Web. This is a database operated by the Norwegian Petroleum Directorate, the Climate and Pollution Agency and the Norwegian Oil Industry Association. The Climate and Pollution Agency aggregates data from the Environmental Web. The data are stored and archived in a designated file on the Climate and Pollution Agency's server before being sent to Statistics Norway.

Methane recovery from landfills

Emission data from the landfill owners are sent to the County Departments of Environmental Affairs and are then stored Forurensning database. After QA/QC, these data (with supplementary notes) are stored and archived in a designated file on the Climate and Pollution Agency's server, before being sent to Statistics Norway

Import of HFC/PFC and SF_6

Companies that import *HFC/PFC and SF_6* in bulk report this information to the Climate and Pollution Agency annually. The reports are archived in Ephorte. After QA/QC, these data (with supplementary notes) are stored and archived in a designated file on the Climate and Pollution Agency's server, before being sent to Statistics Norway.

The Climate and Pollution Agency will work to improve its archiving routines for emissions and other data reported from industrial plants and for emissions and other data reported from oil and gas facilities. Most important will be the improvements with respect to transparency of recalculated data, as FORURENSNING in the future may be able to store the original data.

The CRFs tables and NIR are archived in REPORTNET from 2002 and will also be archived there in the future. Before 2002 the reports are stored at the Climate and Pollution Agency's server. Statistics Norway will also archive the CRF Reporter.

7.7.3 The Norwegian Forest and Landscape Institute

The tables, data programmes etc. are currently being stored on the institute's server. Every night a new backup copy will be made and stored outside the building. This will ensure that no data can disappear due to technical failure. Files that have been left unchanged, thus will exist as long as there is a wish to keep them. Even after purposely deleting or changing the data, the files will exist for 2-3 months, or until the data tapes will be written over with new data.

Annex VI: SUMMARY II REPORT FOR CO_2 EQUIVALENT EMISSIONS 1990-2011

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 1990
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**19 471,36**	**5 031,25**	**4 941,91**	**0,05**	**3 370,40**	**2 199,78**	**35 014,75**
1. Energy	**28 529,52**	**642,01**	**319,75**				**29 491,28**
A. Fuel Combustion (Sectoral Approach)	25 869,80	265,70	315,38				26 450,89
1. Energy Industries	6 891,48	49,47	27,37				6 968,33
2. Manufacturing Industries and Construction	3 522,04	10,41	42,36				3 574,82
3. Transport	10 862,68	83,23	155,60				11 101,51
4. Other Sectors	4 137,41	122,08	83,90				4 343,40
5. Other	456,19	0,50	6,15				462,84
B. Fugitive Emissions from Fuels	2 659,72	376,31	4,36				3 040,39
1. Solid Fuels	7,37	56,49	0,00				63,86
2. Oil and Natural Gas	2 652,35	319,83	4,36				2 976,54
2. Industrial Processes	**6 147,97**	**10,02**	**2 078,84**	**0,05**	**3 370,40**	**2 199,78**	**13 807,06**
A. Mineral Products	728,66	0,00	0,00				728,66
B. Chemical Industry	1 189,86	8,98	2 073,61	NO	NO	NO	3 272,45
C. Metal Production	4 145,91	1,04	5,22	NO	3 370,40	2 143,83	9 666,41
D. Other Production	77,30						77,30
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				0,05	0,00	55,95	56,00
G. Other	6,23	NA	NA	NA,NO	NO	NO	6,23
3. Solvent and Other Product Use	**155,65**		**35,53**				**191,18**
4. Agriculture		**2 635,20**	**2 377,42**				**5 012,63**
A. Enteric Fermentation		2 316,76					2 316,76
B. Manure Management		298,17	152,75				450,92
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 218,83				2 218,83
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		20,27	5,85				26,12
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-15 361,97**	**1,11**	**13,23**				**-15 347,62**
A. Forest Land	-18 148,33	1,11	12,83				-18 134,39
B. Cropland	2 342,99	0,00	0,35				2 343,34
C. Grassland	-17,94	0,00	0,00				-17,94
D. Wetlands	-58,46	0,00	0,05				-58,40
E. Settlements	507,85	0,00	0,00				507,85
F. Other Land	1,81	0,00	0,00				1,81
G. Other	10,12	0,00	0,00				10,12
6. Waste	**0,19**	**1 742,90**	**117,14**				**1 860,23**
A. Solid Waste Disposal on Land	0,00	1 723,37					1 723,37
B. Waste-water Handling	0,00	19,51	117,07				136,58
C. Waste Incineration	0,19	0,01	0,07				0,27
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	50 362,37
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	35 014,75

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 1991
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**16 895,70**	**5 049,37**	**4 782,32**	**9,01**	**2 992,92**	**2 079,15**	**31 808,47**
1. Energy	**27 584,81**	**668,71**	**318,00**				**28 571,53**
A. Fuel Combustion (Sectoral Approach)	25 478,68	252,45	314,94				26 046,06
1. Energy Industries	7 260,88	52,00	31,20				7 344,08
2. Manufacturing Industries and Construction	3 351,85	10,54	43,97				3 406,36
3. Transport	10 748,08	79,66	154,45				10 982,19
4. Other Sectors	3 712,12	109,80	79,61				3 901,53
5. Other	405,75	0,44	5,70				411,90
B. Fugitive Emissions from Fuels	2 106,13	416,27	3,06				2 525,46
1. Solid Fuels	7,84	60,08	0,00				67,92
2. Oil and Natural Gas	2 098,29	356,19	3,06				2 457,55
2. Industrial Processes	**5 647,40**	**8,54**	**1 920,73**	**9,01**	**2 992,92**	**2 079,15**	**12 657,76**
A. Mineral Products	685,00	0,00	0,00				685,00
B. Chemical Industry	1 061,73	7,67	1 916,28	NO	NO	NO	2 985,68
C. Metal Production	3 774,32	0,87	4,45	NO	2 992,92	2 019,55	8 792,12
D. Other Production	120,29						120,29
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				9,01	0,00	59,60	68,61
G. Other	6,06	NA	NA	NA,NO	NO	NO	6,06
3. Solvent and Other Product Use	**136,62**		**35,30**				**171,93**
4. Agriculture		**2 639,95**	**2 376,83**				**5 016,78**
A. Enteric Fermentation		2 317,86					2 317,86
B. Manure Management		306,16	159,61				465,77
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 212,63				2 212,63
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		15,93	4,60				20,53
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-16 473,33**	**1,87**	**14,75**				**-16 456,70**
A. Forest Land	-19 341,50	1,87	13,99				-19 325,64
B. Cropland	2 314,66	0,00	0,70				2 315,37
C. Grassland	-13,31	0,00	0,00				-13,31
D. Wetlands	-62,20	0,00	0,05				-62,15
E. Settlements	613,53	0,00	0,00				613,53
F. Other Land	3,61	0,00	0,00				3,61
G. Other	11,88	0,00	0,00				11,88
6. Waste	**0,19**	**1 730,28**	**116,70**				**1 847,17**
A. Solid Waste Disposal on Land	0,00	1 711,59					1 711,59
B. Waste-water Handling	0,00	18,67	116,63				135,30
C. Waste Incineration	0,19	0,03	0,07				0,29
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	48 265,17
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	31 808,47

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 1992

(Sheet 1 of 1) Submission 2013 v1.1

NORWAY

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**17 730,40**	**5 130,54**	**4 226,31**	**18,12**	**2 286,92**	**705,03**	**30 097,32**
1. Energy	**28 377,80**	**762,49**	**318,10**				**29 458,39**
A. Fuel Combustion (Sectoral Approach)	25 965,16	249,47	314,96				26 529,59
1. Energy Industries	7 833,25	55,47	33,93				7 922,64
2. Manufacturing Industries and Construction	3 266,80	9,85	44,63				3 321,28
3. Transport	10 984,39	76,77	151,59				11 212,76
4. Other Sectors	3 393,82	106,84	76,74				3 577,39
5. Other	486,91	0,53	8,07				495,52
B. Fugitive Emissions from Fuels	2 412,63	513,03	3,14				2 928,80
1. Solid Fuels	6,51	49,90	0,00				56,41
2. Oil and Natural Gas	2 406,12	463,13	3,14				2 872,39
2. Industrial Processes	**5 648,46**	**8,83**	**1 371,44**	**18,12**	**2 286,92**	**705,03**	**10 038,80**
A. Mineral Products	734,83	0,00	0,00				734,83
B. Chemical Industry	1 006,31	7,95	1 366,86	NO	NO	NO	2 381,13
C. Metal Production	3 774,18	0,88	4,57	NO	2 286,92	638,25	6 704,80
D. Other Production	119,85						119,85
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				18,12	0,00	66,78	84,91
G. Other	13,29	NA	NA	NA,NO	NO	NO	13,29
3. Solvent and Other Product Use	**140,81**		**35,21**				**176,02**
4. Agriculture		**2 661,70**	**2 370,30**				**5 032,00**
A. Enteric Fermentation		2 345,72					2 345,72
B. Manure Management		307,31	159,78				467,09
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 208,01				2 208,01
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		8,67	2,50				11,18
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-16 436,86**	**1,72**	**14,98**				**-16 420,16**
A. Forest Land	-19 352,78	1,72	13,87				-19 337,19
B. Cropland	2 275,91	0,00	1,06				2 276,97
C. Grassland	-8,53	0,00	0,00				-8,53
D. Wetlands	-62,22	0,00	0,05				-62,17
E. Settlements	693,48	0,00	0,00				693,48
F. Other Land	5,42	0,00	0,00				5,42
G. Other	11,88	0,00	0,00				11,88
6. Waste	**0,19**	**1 695,79**	**116,29**				**1 812,27**
A. Solid Waste Disposal on Land	0,00	1 677,93					1 677,93
B. Waste-water Handling	0,00	17,83	116,22				134,04
C. Waste Incineration	0,19	0,04	0,07				0,30
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	46 517,47
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	30 097,32

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 1993
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**17 599,49**	**5 181,45**	**4 414,36**	**28,45**	**2 297,72**	**737,71**	**30 259,19**
1. Energy	**29 488,88**	**862,53**	**323,16**				**30 674,56**
A. Fuel Combustion (Sectoral Approach)	26 952,07	264,69	319,84				27 536,60
1. Energy Industries	8 104,75	57,26	33,46				8 195,47
2. Manufacturing Industries and Construction	3 510,57	10,33	48,41				3 569,31
3. Transport	11 633,88	76,09	155,53				11 865,50
4. Other Sectors	3 336,08	120,60	77,34				3 534,03
5. Other	366,79	0,41	5,10				372,30
B. Fugitive Emissions from Fuels	2 536,80	597,84	3,32				3 137,96
1. Solid Fuels	7,22	55,33	0,00				62,55
2. Oil and Natural Gas	2 529,58	542,50	3,32				3 075,41
2. Industrial Processes	**6 174,92**	**8,93**	**1 590,36**	**28,45**	**2 297,72**	**737,71**	**10 838,11**
A. Mineral Products	919,76	0,00	0,00				919,76
B. Chemical Industry	1 061,32	7,94	1 585,36	NO	NO	NO	2 654,62
C. Metal Production	4 041,99	0,99	5,00	NO	2 297,72	663,23	7 008,92
D. Other Production	126,96						126,96
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				28,45	0,00	74,49	102,94
G. Other	24,90	NA	NA	NA,NO	NO	NO	24,90
3. Solvent and Other Product Use	**141,23**		**35,94**				**177,16**
4. Agriculture		**2 625,46**	**2 331,13**				**4 956,59**
A. Enteric Fermentation		2 307,90					2 307,90
B. Manure Management		305,56	154,08				459,65
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 173,59				2 173,59
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		11,99	3,46				15,45
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-18 205,70**	**0,32**	**14,62**				**-18 190,77**
A. Forest Land	-21 255,04	0,32	13,16				-21 241,57
B. Cropland	2 285,95	0,00	1,41				2 287,36
C. Grassland	-1,89	0,00	0,00				-1,89
D. Wetlands	-68,16	0,00	0,05				-68,11
E. Settlements	814,34	0,00	0,00				814,34
F. Other Land	7,22	0,00	0,00				7,22
G. Other	11,88	0,00	0,00				11,88
6. Waste	**0,16**	**1 684,22**	**119,16**				**1 803,54**
A. Solid Waste Disposal on Land	0,00	1 667,20					1 667,20
B. Waste-water Handling	0,00	16,98	119,09				136,07
C. Waste Incineration	0,16	0,04	0,07				0,28
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	48 449,96
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	30 259,19

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 1994
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**20 597,93**	**5 254,41**	**4 497,24**	**44,20**	**2 032,47**	**877,98**	**33 304,24**
1. Energy	**31 010,97**	**901,86**	**354,74**				**32 267,57**
A. Fuel Combustion (Sectoral Approach)	28 347,71	272,45	351,18				28 971,34
1. Energy Industries	8 787,58	59,00	35,68				8 882,26
2. Manufacturing Industries and Construction	4 074,40	11,43	59,18				4 145,01
3. Transport	11 485,32	73,16	176,07				11 734,55
4. Other Sectors	3 492,76	128,43	73,41				3 694,60
5. Other	507,65	0,43	6,84				514,92
B. Fugitive Emissions from Fuels	2 663,26	629,41	3,56				3 296,23
1. Solid Fuels	7,20	55,18	0,00				62,38
2. Oil and Natural Gas	2 656,06	574,24	3,56				3 233,85
2. Industrial Processes	**6 555,82**	**9,65**	**1 646,38**	**44,20**	**2 032,47**	**877,98**	**11 166,50**
A. Mineral Products	937,88	0,00	0,00				937,88
B. Chemical Industry	1 150,01	8,53	1 640,85	NO	NO	NO	2 799,39
C. Metal Production	4 329,04	1,11	5,53	NO	2 032,47	791,09	7 159,24
D. Other Production	125,64						125,64
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				44,20	0,00	86,89	131,09
G. Other	13,26	NA	NA	NA,NO	NO	NO	13,26
3. Solvent and Other Product Use	**151,79**		**38,50**				**190,29**
4. Agriculture		**2 666,55**	**2 318,23**				**4 984,78**
A. Enteric Fermentation		2 349,06					2 349,06
B. Manure Management		308,88	160,39				469,27
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 155,36				2 155,36
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		8,61	2,48				11,10
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-17 120,82**	**0,36**	**14,96**				**-17 105,50**
A. Forest Land	-20 194,33	0,36	13,15				-20 180,82
B. Cropland	2 239,13	0,00	1,76				2 240,89
C. Grassland	3,90	0,00	0,00				3,90
D. Wetlands	-64,81	0,00	0,05				-64,75
E. Settlements	870,90	0,00	0,00				870,90
F. Other Land	9,03	0,00	0,00				9,03
G. Other	15,34	0,00	0,00				15,34
6. Waste	**0,18**	**1 676,00**	**124,43**				**1 800,60**
A. Solid Waste Disposal on Land	0,00	1 659,83					1 659,83
B. Waste-water Handling	0,00	16,12	124,35				140,47
C. Waste Incineration	0,18	0,05	0,07				0,30
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	50 409,74
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	33 304,24

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 1995

(Sheet 1 of 1) Submission 2013 v1.1

NORWAY

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**17 990,19**	**5 199,64**	**4 548,86**	**80,34**	**2 007,96**	**607,79**	**30 434,78**
1. Energy	**30 895,04**	**885,37**	**375,97**				**32 156,38**
A. Fuel Combustion (Sectoral Approach)	28 267,06	266,91	372,34				28 906,31
1. Energy Industries	8 646,77	59,19	36,07				8 742,02
2. Manufacturing Industries and Construction	3 801,45	11,62	61,88				3 874,95
3. Transport	11 880,62	70,37	196,54				12 147,53
4. Other Sectors	3 484,03	125,37	71,05				3 680,46
5. Other	454,19	0,37	6,80				461,36
B. Fugitive Emissions from Fuels	2 627,98	618,45	3,63				3 250,06
1. Solid Fuels	7,09	54,32	0,00				61,41
2. Oil and Natural Gas	2 620,90	564,13	3,63				3 188,66
2. Industrial Processes	**6 748,09**	**10,15**	**1 642,95**	**80,34**	**2 007,96**	**607,79**	**11 097,27**
A. Mineral Products	983,71	0,00	0,00				983,71
B. Chemical Industry	1 166,33	8,99	1 637,19	NO	NO	NO	2 812,51
C. Metal Production	4 449,03	1,16	5,76	NO	2 007,72	509,07	6 972,74
D. Other Production	133,88						133,88
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				80,34	0,24	98,72	179,30
G. Other	15,14	NA	NA	NA,NO	NO	NO	15,14
3. Solvent and Other Product Use	**147,79**		**38,94**				**186,74**
4. Agriculture		**2 667,45**	**2 348,29**				**5 015,75**
A. Enteric Fermentation		2 342,55					2 342,55
B. Manure Management		314,23	161,93				476,16
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 183,29				2 183,29
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		10,67	3,08				13,75
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-19 800,87**	**0,14**	**15,24**				**-19 785,49**
A. Forest Land	-23 021,26	0,14	13,07				-23 008,04
B. Cropland	2 249,50	0,00	2,11				2 251,61
C. Grassland	3,19	0,00	0,00				3,19
D. Wetlands	-73,62	0,00	0,05				-73,56
E. Settlements	1 011,68	0,00	0,00				1 011,68
F. Other Land	10,83	0,00	0,00				10,83
G. Other	18,80	0,00	0,00				18,80
6. Waste	**0,15**	**1 636,53**	**127,46**				**1 764,14**
A. Solid Waste Disposal on Land	0,00	1 621,24					1 621,24
B. Waste-water Handling	0,00	15,24	127,39				142,63
C. Waste Incineration	0,15	0,05	0,07				0,27
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	50 220,27
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	30 434,78

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 1996
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**21 652,64**	**5 229,84**	**4 583,23**	**112,22**	**1 829,46**	**574,10**	**33 981,49**
1. Energy	**34 135,65**	**918,66**	**410,29**				**35 464,60**
A. Fuel Combustion (Sectoral Approach)	31 084,94	275,98	406,09				31 767,02
1. Energy Industries	9 694,36	63,17	38,12				9 795,65
2. Manufacturing Industries and Construction	4 320,85	11,51	61,96				4 394,32
3. Transport	12 452,32	66,47	227,75				12 746,54
4. Other Sectors	4 210,82	134,43	73,28				4 418,54
5. Other	406,60	0,39	4,98				411,97
B. Fugitive Emissions from Fuels	3 050,71	642,67	4,20				3 697,58
1. Solid Fuels	7,24	55,52	0,00				62,76
2. Oil and Natural Gas	3 043,47	587,16	4,20				3 634,82
2. Industrial Processes	**6 748,70**	**9,93**	**1 624,55**	**112,22**	**1 829,46**	**574,10**	**10 898,95**
A. Mineral Products	985,51	0,00	0,00				985,51
B. Chemical Industry	1 167,64	8,70	1 618,42	NO	NO	NO	2 794,76
C. Metal Production	4 440,65	1,23	6,13	NO	1 829,04	472,50	6 749,54
D. Other Production	135,43						135,43
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				112,22	0,42	101,60	214,24
G. Other	19,46	NA	NA	NA,NO	NO	NO	19,46
3. Solvent and Other Product Use	**156,06**		**39,51**				**195,57**
4. Agriculture		**2 699,55**	**2 366,37**				**5 065,93**
A. Enteric Fermentation		2 367,90					2 367,90
B. Manure Management		320,02	163,46				483,47
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 199,56				2 199,56
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		11,64	3,36				15,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-19 387,90**	**0,98**	**15,81**				**-19 371,12**
A. Forest Land	-22 650,03	0,98	13,29				-22 635,76
B. Cropland	2 208,42	0,00	2,46				2 210,88
C. Grassland	5,84	0,00	0,00				5,84
D. Wetlands	-72,41	0,00	0,05				-72,36
E. Settlements	1 083,11	0,00	0,00				1 083,11
F. Other Land	12,64	0,00	0,00				12,64
G. Other	24,53	0,00	0,00				24,53
6. Waste	**0,13**	**1 600,73**	**126,70**				**1 727,56**
A. Solid Waste Disposal on Land	0,00	1 586,32					1 586,32
B. Waste-water Handling	0,00	14,35	126,63				140,98
C. Waste Incineration	0,13	0,06	0,07				0,26
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	53 352,61
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	33 981,49

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 1997
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**22 127,25**	**5 234,02**	**4 570,82**	**164,81**	**1 633,25**	**579,86**	**34 310,00**
1. Energy	**33 969,04**	**988,20**	**416,91**				**35 374,15**
A. Fuel Combustion (Sectoral Approach)	31 170,94	282,44	412,88				31 866,26
1. Energy Industries	10 061,18	66,85	38,34				10 166,38
2. Manufacturing Industries and Construction	4 210,33	12,16	63,93				4 286,43
3. Transport	12 698,90	64,59	232,47				12 995,97
4. Other Sectors	3 775,95	138,43	71,61				3 985,99
5. Other	424,57	0,41	6,52				431,51
B. Fugitive Emissions from Fuels	2 798,10	705,76	4,03				3 507,88
1. Solid Fuels	6,34	48,61	0,00				54,95
2. Oil and Natural Gas	2 791,76	657,15	4,03				3 452,94
2. Industrial Processes	**7 022,32**	**11,85**	**1 611,79**	**164,81**	**1 633,25**	**579,86**	**11 023,89**
A. Mineral Products	1 042,69	0,00	0,00				1 042,69
B. Chemical Industry	1 219,18	10,56	1 605,31	NO	NO	NO	2 835,05
C. Metal Production	4 590,05	1,29	6,49	NO	1 632,90	437,37	6 668,10
D. Other Production	152,14						152,14
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				164,81	0,34	142,49	307,64
G. Other	18,27	NA	NA	NA,NO	NO	NO	18,27
3. Solvent and Other Product Use	**150,60**		**39,44**				**190,04**
4. Agriculture		**2 672,45**	**2 358,25**				**5 030,70**
A. Enteric Fermentation		2 343,47					2 343,47
B. Manure Management		320,61	158,92				479,52
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 196,92				2 196,92
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		8,37	2,42				10,79
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-19 014,85**	**1,07**	**16,29**				**-18 997,49**
A. Forest Land	-22 390,63	1,07	13,42				-22 376,14
B. Cropland	2 234,18	0,00	2,82				2 237,00
C. Grassland	14,57	0,00	0,00				14,57
D. Wetlands	-71,55	0,00	0,05				-71,50
E. Settlements	1 156,91	0,00	0,00				1 156,91
F. Other Land	14,45	0,00	0,00				14,45
G. Other	27,22	0,00	0,00				27,22
6. Waste	**0,14**	**1 560,44**	**128,14**				**1 688,72**
A. Solid Waste Disposal on Land	0,00	1 546,91					1 546,91
B. Waste-water Handling	0,00	13,45	128,07				141,52
C. Waste Incineration	0,14	0,08	0,07				0,29
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	53 307,49
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	34 310,00

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 1998
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**21 471,22**	**5 086,78**	**4 610,52**	**209,78**	**1 485,80**	**726,74**	**33 590,83**
1. Energy	**34 071,35**	**936,61**	**374,20**				**35 382,16**
A. Fuel Combustion (Sectoral Approach)	31 183,45	269,22	370,15				31 822,82
1. Energy Industries	9 749,73	64,56	37,77				9 852,07
2. Manufacturing Industries and Construction	4 374,54	11,58	50,15				4 436,27
3. Transport	12 861,63	60,37	199,99				13 121,99
4. Other Sectors	3 837,98	132,34	74,19				4 044,51
5. Other	359,57	0,37	8,05				367,98
B. Fugitive Emissions from Fuels	2 887,90	667,39	4,05				3 559,34
1. Solid Fuels	6,59	50,52	0,00				57,12
2. Oil and Natural Gas	2 881,31	616,87	4,05				3 502,22
2. Industrial Processes	**7 147,45**	**12,05**	**1 693,11**	**209,78**	**1 485,80**	**726,74**	**11 274,93**
A. Mineral Products	1 019,07	0,00	0,00				1 019,07
B. Chemical Industry	1 052,28	10,72	1 686,56	NO	NO	NO	2 749,56
C. Metal Production	4 952,25	1,33	6,55	NO	1 485,49	581,97	7 027,58
D. Other Production	102,81						102,81
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				209,78	0,31	144,77	354,86
G. Other	21,03	NA	NA	NA,NO	NO	NO	21,03
3. Solvent and Other Product Use	**150,94**		**39,51**				**190,45**
4. Agriculture		**2 686,70**	**2 358,46**				**5 045,16**
A. Enteric Fermentation		2 353,17					2 353,17
B. Manure Management		324,73	157,99				482,73
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 197,93				2 197,93
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		8,79	2,54				11,33
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-19 898,66**	**0,39**	**16,69**				**-19 881,59**
A. Forest Land	-23 297,12	0,39	13,46				-23 283,27
B. Cropland	2 169,33	0,00	3,17				2 172,50
C. Grassland	7,95	0,00	0,00				7,95
D. Wetlands	-74,34	0,00	0,05				-74,29
E. Settlements	1 256,04	0,00	0,00				1 256,04
F. Other Land	16,25	0,00	0,00				16,25
G. Other	23,23	0,00	0,00				23,23
6. Waste	**0,15**	**1 451,02**	**128,55**				**1 579,72**
A. Solid Waste Disposal on Land	0,00	1 438,36					1 438,36
B. Waste-water Handling	0,00	12,55	128,47				141,03
C. Waste Incineration	0,15	0,11	0,07				0,33
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	53 472,42
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	33 590,83

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 1999

(Sheet 1 of 1) Submission 2013 v1.1

NORWAY

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**27 240,48**	**5 006,52**	**4 842,84**	**270,78**	**1 388,70**	**873,96**	**39 623,27**
1. Energy	**34 953,38**	**909,83**	**404,24**				**36 267,44**
A. Fuel Combustion (Sectoral Approach)	31 448,98	265,37	398,94				32 113,29
1. Energy Industries	9 714,30	60,15	37,91				9 812,37
2. Manufacturing Industries and Construction	3 951,75	11,74	42,35				4 005,84
3. Transport	13 460,42	57,94	238,86				13 757,22
4. Other Sectors	3 930,95	135,18	73,53				4 139,67
5. Other	391,56	0,36	6,28				398,21
B. Fugitive Emissions from Fuels	3 504,39	644,46	5,30				4 154,15
1. Solid Fuels	8,47	64,88	0,00				73,35
2. Oil and Natural Gas	3 495,93	579,58	5,30				4 080,80
2. Industrial Processes	**7 018,03**	**10,05**	**1 923,32**	**270,78**	**1 388,70**	**873,96**	**11 484,84**
A. Mineral Products	986,85	0,00	0,00				986,85
B. Chemical Industry	874,65	8,78	1 916,96	NO	NO	NO	2 800,39
C. Metal Production	5 056,32	1,28	6,36	NO	1 388,42	725,37	7 177,75
D. Other Production	79,28						79,28
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				270,78	0,28	148,59	419,65
G. Other	20,92	NA	NA	NA,NO	NO	NO	20,92
3. Solvent and Other Product Use	**148,08**		**40,20**				**188,27**
4. Agriculture		**2 752,46**	**2 328,85**				**5 081,31**
A. Enteric Fermentation		2 422,58					2 422,58
B. Manure Management		321,98	161,72				483,70
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 164,85				2 164,85
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		7,90	2,28				10,18
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-14 879,13**	**0,08**	**16,99**				**-14 862,05**
A. Forest Land	-18 731,42	0,08	13,44				-18 717,90
B. Cropland	2 225,40	0,00	3,50				2 228,91
C. Grassland	115,91	0,00	0,00				115,91
D. Wetlands	-61,78	0,00	0,05				-61,73
E. Settlements	1 530,46	0,00	0,00				1 530,46
F. Other Land	16,25	0,00	0,00				16,25
G. Other	26,04	0,00	0,00				26,04
6. Waste	**0,12**	**1 334,09**	**129,24**				**1 463,45**
A. Solid Waste Disposal on Land	0,00	1 322,30					1 322,30
B. Waste-water Handling	0,00	11,65	129,16				140,82
C. Waste Incineration	0,12	0,13	0,08				0,33
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	54 485,32
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	39 623,27

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2000
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**26 777,93**	**5 057,81**	**4 605,82**	**327,32**	**1 318,11**	**934,42**	**39 021,42**
1. Energy	**34 201,33**	**1 023,65**	**365,28**				**35 590,26**
A. Fuel Combustion (Sectoral Approach)	30 486,75	268,64	360,35				31 115,74
1. Energy Industries	10 653,05	65,89	36,78				10 755,72
2. Manufacturing Industries and Construction	3 784,26	10,81	38,84				3 833,91
3. Transport	12 635,28	54,57	210,64				12 900,49
4. Other Sectors	3 236,00	137,10	70,36				3 443,46
5. Other	178,16	0,27	3,73				182,16
B. Fugitive Emissions from Fuels	3 714,58	755,01	4,93				4 474,52
1. Solid Fuels	9,25	70,86	0,00				80,11
2. Oil and Natural Gas	3 705,33	684,15	4,93				4 394,41
2. Industrial Processes	**7 447,74**	**10,08**	**1 739,12**	**327,32**	**1 318,11**	**934,42**	**11 776,80**
A. Mineral Products	993,92	0,00	0,00				993,92
B. Chemical Industry	1 130,72	8,78	1 732,89	NO	NO	NO	2 872,38
C. Metal Production	5 070,58	1,30	6,24	NO	1 317,86	773,17	7 169,15
D. Other Production	232,01						232,01
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				327,32	0,25	161,26	488,83
G. Other	20,50	NA	NA	NA,NO	NO	NO	20,50
3. Solvent and Other Product Use	**141,69**		**40,04**				**181,74**
4. Agriculture		**2 647,26**	**2 327,83**				**4 975,10**
A. Enteric Fermentation		2 319,68					2 319,68
B. Manure Management		319,17	163,83				483,00
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 161,57				2 161,57
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		8,42	2,43				10,84
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-15 012,91**	**0,17**	**17,05**				**-14 995,68**
A. Forest Land	-18 881,11	0,17	12,83				-18 868,10
B. Cropland	2 032,07	0,00	4,17				2 036,24
C. Grassland	217,23	0,00	0,00				217,23
D. Wetlands	-34,44	0,00	0,05				-34,39
E. Settlements	1 610,66	0,00	0,00				1 610,66
F. Other Land	16,25	0,00	0,00				16,25
G. Other	26,43	0,00	0,00				26,43
6. Waste	**0,07**	**1 376,64**	**116,49**				**1 493,21**
A. Solid Waste Disposal on Land	0,00	1 365,80					1 365,80
B. Waste-water Handling	0,00	10,74	116,42				127,16
C. Waste Incineration	0,07	0,10	0,07				0,25
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	54 017,10
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	39 021,42

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2001
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**24 504,51**	**5 068,53**	**4 524,93**	**403,07**	**1 328,81**	**791,20**	**36 621,05**
1. Energy	**35 983,57**	**1 129,50**	**395,32**				**37 508,39**
A. Fuel Combustion (Sectoral Approach)	32 565,42	278,77	390,94				33 235,13
1. Energy Industries	11 888,81	73,20	39,28				12 001,29
2. Manufacturing Industries and Construction	3 864,68	11,44	45,21				3 921,33
3. Transport	12 926,45	50,35	221,90				13 198,70
4. Other Sectors	3 590,56	143,35	80,42				3 814,34
5. Other	294,91	0,41	4,14				299,46
B. Fugitive Emissions from Fuels	3 418,15	850,73	4,38				4 273,26
1. Solid Fuels	8,39	64,30	0,00				72,68
2. Oil and Natural Gas	3 409,76	786,43	4,38				4 200,58
2. Industrial Processes	**7 031,64**	**10,30**	**1 688,70**	**403,07**	**1 328,81**	**791,20**	**11 253,73**
A. Mineral Products	954,14	0,00	0,00				954,14
B. Chemical Industry	1 091,02	9,15	1 683,11	NO	NO	NO	2 783,28
C. Metal Production	4 747,80	1,15	5,60	NO	1 328,59	645,30	6 728,43
D. Other Production	217,26						217,26
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				403,07	0,22	145,90	549,20
G. Other	21,42	NA	NA	NA,NO	NO	NO	21,42
3. Solvent and Other Product Use	**144,32**		**40,04**				**184,36**
4. Agriculture		**2 610,49**	**2 263,72**				**4 874,22**
A. Enteric Fermentation		2 292,61					2 292,61
B. Manure Management		311,25	164,09				475,33
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 097,72				2 097,72
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		6,64	1,92				8,55
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-18 655,09**	**0,07**	**18,78**				**-18 636,24**
A. Forest Land	-22 578,22	0,07	12,94				-22 565,21
B. Cropland	2 180,21	0,00	5,79				2 185,99
C. Grassland	164,63	0,00	0,00				164,63
D. Wetlands	-44,84	0,00	0,05				-44,79
E. Settlements	1 583,07	0,00	0,00				1 583,07
F. Other Land	16,25	0,00	0,00				16,25
G. Other	23,81	0,00	0,00				23,81
6. Waste	**0,07**	**1 318,16**	**118,36**				**1 436,59**
A. Solid Waste Disposal on Land	0,00	1 308,27					1 308,27
B. Waste-water Handling	0,00	9,79	118,29				128,08
C. Waste Incineration	0,07	0,10	0,07				0,24
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	55 257,29
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	36 621,05

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2002
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**21 075,42**	**4 937,69**	**4 734,77**	**491,79**	**1 437,76**	**238,30**	**32 915,73**
1. Energy	**35 670,43**	**1 066,18**	**387,19**				**37 123,80**
A. Fuel Combustion (Sectoral Approach)	32 753,23	297,45	383,82				33 434,50
1. Energy Industries	12 131,27	76,21	40,84				12 248,31
2. Manufacturing Industries and Construction	3 641,47	10,89	42,58				3 694,94
3. Transport	12 768,70	46,92	218,34				13 033,96
4. Other Sectors	3 758,56	163,11	77,53				3 999,20
5. Other	453,23	0,32	4,54				458,09
B. Fugitive Emissions from Fuels	2 917,20	768,73	3,37				3 689,30
1. Solid Fuels	7,74	59,36	0,00				67,10
2. Oil and Natural Gas	2 909,46	709,37	3,37				3 622,20
2. Industrial Processes	**6 464,95**	**11,65**	**1 914,46**	**491,79**	**1 437,76**	**238,30**	**10 558,91**
A. Mineral Products	981,11	0,00	0,00				981,11
B. Chemical Industry	969,35	10,69	1 909,80	NO	NO	NO	2 889,84
C. Metal Production	4 260,56	0,96	4,66	NO	1 437,56	141,73	5 845,47
D. Other Production	233,60						233,60
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				491,79	0,20	96,58	588,57
G. Other	20,32	NA	NA	NA,NO	NO	NO	20,32
3. Solvent and Other Product Use	**147,11**		**40,10**				**187,22**
4. Agriculture		**2 604,86**	**2 263,96**				**4 868,82**
A. Enteric Fermentation		2 294,80					2 294,80
B. Manure Management		305,09	162,51				467,60
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 100,02				2 100,02
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		4,97	1,44				6,41
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-21 207,12**	**0,33**	**18,91**				**-21 187,88**
A. Forest Land	-25 649,50	0,33	13,07				-25 636,11
B. Cropland	2 034,27	0,00	5,79				2 040,06
C. Grassland	63,24	0,00	0,00				63,24
D. Wetlands	-48,74	0,00	0,05				-48,69
E. Settlements	2 358,84	0,00	0,00				2 358,84
F. Other Land	16,25	0,00	0,00				16,25
G. Other	18,52	0,00	0,00				18,52
6. Waste	**0,04**	**1 254,67**	**110,15**				**1 364,87**
A. Solid Waste Disposal on Land	0,00	1 245,73					1 245,73
B. Waste-water Handling	0,00	8,84	110,08				118,92
C. Waste Incineration	0,04	0,10	0,07				0,21
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	54 103,62
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	32 915,73

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2003
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**20 404,02**	**5 015,76**	**4 587,98**	**475,15**	**909,25**	**227,86**	**31 620,01**
1. Energy	**36 940,01**	**1 124,58**	**401,95**				**38 466,54**
A. Fuel Combustion (Sectoral Approach)	34 110,15	304,46	398,88				34 813,49
1. Energy Industries	12 831,27	81,67	44,32				12 957,26
2. Manufacturing Industries and Construction	3 942,76	11,33	44,10				3 998,19
3. Transport	13 118,74	48,86	229,45				13 397,05
4. Other Sectors	4 044,93	162,31	79,50				4 286,73
5. Other	172,46	0,29	1,51				174,26
B. Fugitive Emissions from Fuels	2 829,86	820,11	3,07				3 653,04
1. Solid Fuels	11,89	91,16	0,00				103,05
2. Oil and Natural Gas	2 817,97	728,96	3,07				3 549,99
2. Industrial Processes	**6 557,37**	**8,09**	**1 715,62**	**475,15**	**909,25**	**227,86**	**9 893,33**
A. Mineral Products	1 032,44	0,00	0,00				1 032,44
B. Chemical Industry	1 014,39	7,18	1 711,29	NO	NO	NO	2 732,86
C. Metal Production	4 256,24	0,91	4,33	NO	909,07	172,08	5 342,62
D. Other Production	231,57						231,57
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				475,15	0,18	55,78	531,10
G. Other	22,73	NA	NA	NA,NO	NO	NO	22,73
3. Solvent and Other Product Use	**149,89**		**40,69**				**190,58**
4. Agriculture		**2 645,49**	**2 292,96**				**4 938,45**
A. Enteric Fermentation		2 332,85					2 332,85
B. Manure Management		308,46	147,89				456,35
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 143,86				2 143,86
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		4,18	1,20				5,38
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-23 243,29**	**0,72**	**19,55**				**-23 223,02**
A. Forest Land	-27 489,45	0,72	12,51				-27 476,21
B. Cropland	2 232,88	0,00	6,99				2 239,87
C. Grassland	262,30	0,00	0,00				262,30
D. Wetlands	-54,53	0,00	0,05				-54,48
E. Settlements	1 754,60	0,00	0,00				1 754,60
F. Other Land	32,50	0,00	0,00				32,50
G. Other	18,41	0,00	0,00				18,41
6. Waste	**0,04**	**1 236,88**	**117,21**				**1 354,13**
A. Solid Waste Disposal on Land	0,00	1 229,20					1 229,20
B. Waste-water Handling	0,00	7,59	117,14				124,73
C. Waste Incineration	0,04	0,09	0,07				0,20
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	54 843,02
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	31 620,01

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2004
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**17 309,60**	**4 978,16**	**4 738,79**	**507,56**	**880,06**	**276,05**	**28 690,22**
1. Energy	**36 838,06**	**1 152,30**	**412,83**				**38 403,19**
A. Fuel Combustion (Sectoral Approach)	34 147,41	298,45	409,52				34 855,38
1. Energy Industries	12 939,34	85,09	41,96				13 066,39
2. Manufacturing Industries and Construction	3 685,60	11,00	42,87				3 739,48
3. Transport	13 584,98	50,14	242,13				13 877,25
4. Other Sectors	3 607,34	151,91	79,32				3 838,57
5. Other	330,15	0,30	3,24				333,69
B. Fugitive Emissions from Fuels	2 690,65	853,86	3,31				3 547,81
1. Solid Fuels	7,61	58,34	0,00				65,95
2. Oil and Natural Gas	2 683,04	795,51	3,31				3 481,86
2. Industrial Processes	**7 066,02**	**7,45**	**1 854,12**	**507,56**	**880,06**	**276,05**	**10 591,26**
A. Mineral Products	844,38	0,00	0,00				844,38
B. Chemical Industry	1 059,08	6,36	1 848,87	NO	NO	NO	2 914,31
C. Metal Production	4 888,47	1,08	5,25	NO	879,90	205,54	5 980,24
D. Other Production	242,97						242,97
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				507,56	0,16	70,51	578,24
G. Other	31,12	NA	NA	NA,NO	NO	NO	31,12
3. Solvent and Other Product Use	**153,12**		**41,19**				**194,31**
4. Agriculture		**2 589,87**	**2 293,89**				**4 883,76**
A. Enteric Fermentation		2 274,53					2 274,53
B. Manure Management		310,66	145,77				456,43
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 146,77				2 146,77
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		4,68	1,35				6,04
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-26 747,65**	**0,14**	**19,79**				**-26 727,73**
A. Forest Land	-30 741,43	0,14	12,41				-30 728,88
B. Cropland	1 993,66	0,00	7,32				2 000,98
C. Grassland	61,63	0,00	0,00				61,63
D. Wetlands	-70,05	0,00	0,05				-70,00
E. Settlements	1 960,19	0,00	0,00				1 960,19
F. Other Land	32,50	0,00	0,00				32,50
G. Other	15,84	0,00	0,00				15,84
6. Waste	**0,04**	**1 228,40**	**116,97**				**1 345,42**
A. Solid Waste Disposal on Land	0,00	1 219,20					1 219,20
B. Waste-water Handling	0,00	9,11	116,91				126,02
C. Waste Incineration	0,04	0,09	0,07				0,20
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	55 417,94
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	28 690,22

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2005
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**16 231,85**	**4 763,08**	**4 810,21**	**524,05**	**828,71**	**312,03**	**27 469,94**
1. Energy	**36 303,03**	**1 023,06**	**367,86**				**37 693,95**
A. Fuel Combustion (Sectoral Approach)	33 704,35	295,09	364,67				34 364,10
1. Energy Industries	13 207,79	83,16	41,36				13 332,30
2. Manufacturing Industries and Construction	3 425,29	10,70	37,17				3 473,15
3. Transport	13 503,49	49,57	202,94				13 755,99
4. Other Sectors	3 278,63	151,46	80,34				3 510,43
5. Other	289,15	0,21	2,87				292,23
B. Fugitive Emissions from Fuels	2 598,68	727,97	3,19				3 329,85
1. Solid Fuels	6,77	42,27	0,00				49,04
2. Oil and Natural Gas	2 591,91	685,71	3,19				3 280,81
2. Industrial Processes	**6 613,90**	**7,20**	**1 959,90**	**524,05**	**828,71**	**312,03**	**10 245,80**
A. Mineral Products	906,97	0,00	0,00				906,97
B. Chemical Industry	814,45	6,26	1 955,65	NO	NO	NO	2 776,36
C. Metal Production	4 653,90	0,94	4,25	NO	828,61	240,15	5 727,85
D. Other Production	200,35						200,35
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				524,05	0,10	71,88	596,03
G. Other	38,23	NA	NA	NA,NO	NO	NO	38,23
3. Solvent and Other Product Use	**142,49**		**41,47**				**183,96**
4. Agriculture		**2 578,49**	**2 299,70**				**4 878,19**
A. Enteric Fermentation		2 259,56					2 259,56
B. Manure Management		315,00	146,29				461,29
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 152,27				2 152,27
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		3,93	1,13				5,06
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-26 827,61**	**0,41**	**21,40**				**-26 805,80**
A. Forest Land	-31 351,02	0,41	12,49				-31 338,12
B. Cropland	2 099,49	0,00	8,86				2 108,35
C. Grassland	140,92	0,00	0,00				140,92
D. Wetlands	-43,52	0,00	0,05				-43,47
E. Settlements	2 276,98	0,00	0,00				2 276,98
F. Other Land	32,50	0,00	0,00				32,50
G. Other	17,02	0,00	0,00				17,02
6. Waste	**0,04**	**1 153,91**	**119,89**				**1 273,84**
A. Solid Waste Disposal on Land	0,00	1 144,48					1 144,48
B. Waste-water Handling	0,00	9,36	119,82				129,17
C. Waste Incineration	0,04	0,07	0,07				0,19
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	54 275,75
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	27 469,94

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2006
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**21 748,69**	**4 654,32**	**4 473,80**	**579,46**	**742,51**	**212,09**	**32 410,86**
1. Energy	**37 133,33**	**951,25**	**392,32**				**38 476,91**
A. Fuel Combustion (Sectoral Approach)	34 616,04	294,28	389,22				35 299,54
1. Energy Industries	13 193,77	83,33	42,35				13 319,45
2. Manufacturing Industries and Construction	3 740,86	11,38	40,11				3 792,35
3. Transport	14 122,12	48,00	225,02				14 395,14
4. Other Sectors	3 281,66	151,34	78,99				3 511,98
5. Other	277,63	0,23	2,75				280,62
B. Fugitive Emissions from Fuels	2 517,29	656,97	3,10				3 177,36
1. Solid Fuels	5,37	41,12	0,00				46,48
2. Oil and Natural Gas	2 511,93	615,85	3,10				3 130,88
2. Industrial Processes	**6 198,84**	**7,00**	**1 630,24**	**579,46**	**742,51**	**212,09**	**9 370,13**
A. Mineral Products	944,69	0,00	0,00				944,69
B. Chemical Industry	909,04	6,38	1 627,31	NO	NO	NO	2 542,74
C. Metal Production	4 096,16	0,62	2,92	NO	742,46	120,08	4 962,24
D. Other Production	210,30						210,30
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				579,46	0,05	92,01	671,51
G. Other	38,65	NA	NA	NA,NO	NO	NO	38,65
3. Solvent and Other Product Use	**131,57**		**42,43**				**174,00**
4. Agriculture		**2 521,75**	**2 263,51**				**4 785,27**
A. Enteric Fermentation		2 211,96					2 211,96
B. Manure Management		306,51	145,25				451,75
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 117,32				2 117,32
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		3,28	0,95				4,23
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-21 715,05**	**3,76**	**21,47**				**-21 689,82**
A. Forest Land	-26 116,23	3,76	12,56				-26 099,91
B. Cropland	1 985,47	0,00	8,86				1 994,33
C. Grassland	144,98	0,00	0,00				144,98
D. Wetlands	-26,21	0,00	0,05				-26,15
E. Settlements	2 245,83	0,00	0,00				2 245,83
F. Other Land	32,50	0,00	0,00				32,50
G. Other	18,59	0,00	0,00				18,59
6. Waste	**0,00**	**1 170,55**	**123,83**				**1 294,39**
A. Solid Waste Disposal on Land	0,00	1 160,90					1 160,90
B. Waste-water Handling	0,00	9,59	123,76				133,35
C. Waste Incineration	0,00	0,07	0,07				0,13
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	54 100,69
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	32 410,86

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2007
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**23 773,38**	**4 740,46**	**4 301,36**	**612,11**	**820,94**	**76,24**	**34 324,48**
1. Energy	**38 895,62**	**1 082,34**	**427,63**				**40 405,58**
A. Fuel Combustion (Sectoral Approach)	35 166,14	314,49	420,84				35 901,46
1. Energy Industries	13 529,31	84,12	42,55				13 655,98
2. Manufacturing Industries and Construction	3 466,63	11,35	40,70				3 518,68
3. Transport	14 897,72	71,04	257,15				15 225,90
4. Other Sectors	3 062,96	147,79	78,24				3 288,99
5. Other	209,52	0,19	2,20				211,91
B. Fugitive Emissions from Fuels	3 729,48	767,85	6,79				4 504,12
1. Solid Fuels	8,59	65,85	0,00				74,44
2. Oil and Natural Gas	3 720,89	702,01	6,79				4 429,68
2. Industrial Processes	**6 453,38**	**6,34**	**1 380,79**	**612,11**	**820,94**	**76,24**	**9 349,79**
A. Mineral Products	1 003,92	0,00	0,00				1 003,92
B. Chemical Industry	836,82	5,62	1 377,99	NO	NO	NO	2 220,43
C. Metal Production	4 400,65	0,72	2,80	NO	820,87	0,00	5 225,03
D. Other Production	165,23						165,23
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				612,11	0,07	76,24	688,41
G. Other	46,76	NA	NA	NA,NO	NO	NO	46,76
3. Solvent and Other Product Use	**133,03**		**42,03**				**175,06**
4. Agriculture		**2 504,57**	**2 298,40**				**4 802,96**
A. Enteric Fermentation		2 187,46					2 187,46
B. Manure Management		313,98	148,97				462,95
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 148,53				2 148,53
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		3,12	0,90				4,02
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-21 708,64**	**0,28**	**21,59**				**-21 686,77**
A. Forest Land	-25 599,96	0,28	12,47				-25 587,21
B. Cropland	1 937,48	0,00	9,06				1 946,55
C. Grassland	113,37	0,00	0,00				113,37
D. Wetlands	-24,57	0,00	0,05				-24,52
E. Settlements	1 816,09	0,00	0,00				1 816,09
F. Other Land	32,50	0,00	0,00				32,50
G. Other	16,45	0,00	0,00				16,45
6. Waste	**0,00**	**1 146,94**	**130,93**				**1 277,86**
A. Solid Waste Disposal on Land	0,00	1 136,86					1 136,86
B. Waste-water Handling	0,00	10,01	130,86				140,86
C. Waste Incineration	0,00	0,08	0,07				0,15
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	56 011,25
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	34 324,48

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2008
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**19 888,90**	**4 607,11**	**3 823,91**	**691,95**	**772,75**	**65,40**	**29 850,01**
1. Energy	**37 578,17**	**1 015,44**	**413,42**				**39 007,03**
A. Fuel Combustion (Sectoral Approach)	34 543,23	323,55	407,36				35 274,14
1. Energy Industries	13 557,68	88,09	46,10				13 691,87
2. Manufacturing Industries and Construction	3 476,78	11,73	42,49				3 531,00
3. Transport	14 345,78	76,46	237,89				14 660,13
4. Other Sectors	2 910,48	146,98	76,76				3 134,23
5. Other	252,50	0,29	4,12				256,91
B. Fugitive Emissions from Fuels	3 034,95	691,89	6,06				3 732,89
1. Solid Fuels	5,91	45,33	0,00				51,25
2. Oil and Natural Gas	3 029,03	646,56	6,06				3 681,64
2. Industrial Processes	**6 705,45**	**6,46**	**938,57**	**691,95**	**772,75**	**65,40**	**9 180,57**
A. Mineral Products	1 026,99	0,00	0,00				1 026,99
B. Chemical Industry	897,97	5,55	934,89	NO	NO	NO	1 838,42
C. Metal Production	4 535,31	0,90	3,67	NO	772,70	0,00	5 312,59
D. Other Production	198,77						198,77
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				691,95	0,05	65,40	757,39
G. Other	46,40	NA	NA	NA,NO	NO	NO	46,40
3. Solvent and Other Product Use	**127,43**		**42,87**				**170,30**
4. Agriculture		**2 482,36**	**2 272,83**				**4 755,18**
A. Enteric Fermentation		2 163,18					2 163,18
B. Manure Management		315,88	152,50				468,38
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	2 119,38				2 119,38
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		3,29	0,95				4,24
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-24 522,15**	**5,75**	**22,62**				**-24 493,77**
A. Forest Land	-28 956,93	5,75	13,18				-28 938,00
B. Cropland	1 943,60	0,00	9,40				1 952,99
C. Grassland	276,47	0,00	0,00				276,47
D. Wetlands	-52,97	0,00	0,05				-52,92
E. Settlements	2 215,99	0,00	0,00				2 215,99
F. Other Land	32,50	0,00	0,00				32,50
G. Other	19,18	0,00	0,00				19,18
6. Waste	**0,00**	**1 097,10**	**133,60**				**1 230,70**
A. Solid Waste Disposal on Land	0,00	1 087,14					1 087,14
B. Waste-water Handling	0,00	9,87	133,53				143,40
C. Waste Incineration	0,00	0,09	0,07				0,16
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	54 343,78
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	29 850,01

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2009
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**20 660,54**	**4 506,96**	**3 212,15**	**736,47**	**376,72**	**61,46**	**29 554,29**
1. Energy	**37 480,78**	**992,36**	**391,83**				**38 864,96**
A. Fuel Combustion (Sectoral Approach)	35 080,32	336,63	388,40				35 805,34
1. Energy Industries	14 313,41	94,54	48,62				14 456,57
2. Manufacturing Industries and Construction	3 209,32	9,85	33,10				3 252,26
3. Transport	14 172,40	81,02	224,84				14 478,26
4. Other Sectors	3 121,59	150,89	77,52				3 350,00
5. Other	263,60	0,33	4,32				268,25
B. Fugitive Emissions from Fuels	2 400,46	655,73	3,43				3 059,62
1. Solid Fuels	4,60	35,25	0,00				39,85
2. Oil and Natural Gas	2 395,86	620,48	3,43				3 019,77
2. Industrial Processes	**5 315,63**	**5,24**	**464,80**	**736,47**	**376,72**	**61,46**	**6 960,31**
A. Mineral Products	1 012,14	0,00	0,00				1 012,14
B. Chemical Industry	785,68	4,44	461,06	NO	NO	NO	1 251,19
C. Metal Production	3 291,07	0,80	3,74	NO	376,72	0,00	3 672,32
D. Other Production	180,76						180,76
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				736,47	0,00	61,46	797,92
G. Other	45,97	NA	NA	NA,NO	NO	NO	45,97
3. Solvent and Other Product Use	**106,34**		**44,25**				**150,59**
4. Agriculture		**2 395,34**	**2 150,45**				**4 545,79**
A. Enteric Fermentation		2 078,14					2 078,14
B. Manure Management		315,15	150,66				465,82
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	1 999,20				1 999,20
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		2,04	0,59				2,63
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-22 242,21**	**1,05**	**22,19**				**-22 218,96**
A. Forest Land	-26 725,27	1,05	12,74				-26 711,48
B. Cropland	1 912,67	0,00	9,40				1 922,07
C. Grassland	274,51	0,00	0,00				274,51
D. Wetlands	-60,04	0,00	0,05				-59,99
E. Settlements	2 306,77	0,00	0,00				2 306,77
F. Other Land	32,50	0,00	0,00				32,50
G. Other	16,65	0,00	0,00				16,65
6. Waste	**0,00**	**1 112,97**	**138,63**				**1 251,60**
A. Solid Waste Disposal on Land	0,00	1 103,56					1 103,56
B. Waste-water Handling	0,00	9,32	138,56				147,88
C. Waste Incineration	0,00	0,08	0,07				0,15
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	51 773,25
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	29 554,29

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2010
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**21 945,45**	**4 523,64**	**3 075,23**	**914,44**	**205,08**	**75,38**	**30 739,22**
1. Energy	**39 244,42**	**1 038,82**	**439,17**				**40 722,41**
A. Fuel Combustion (Sectoral Approach)	36 597,71	364,53	435,43				37 397,66
1. Energy Industries	14 727,78	96,81	51,16				14 875,75
2. Manufacturing Industries and Construction	3 482,04	11,80	41,85				3 535,70
3. Transport	14 762,74	85,25	257,96				15 105,94
4. Other Sectors	3 358,31	168,38	79,70				3 606,39
5. Other	266,83	2,30	4,76				273,89
B. Fugitive Emissions from Fuels	2 646,71	674,29	3,75				3 324,75
1. Solid Fuels	4,11	31,48	0,00				35,59
2. Oil and Natural Gas	2 642,61	642,81	3,75				3 289,16
2. Industrial Processes	**6 176,65**	**6,60**	**361,31**	**914,44**	**205,08**	**75,38**	**7 739,46**
A. Mineral Products	1 031,40	0,00	0,00				1 031,40
B. Chemical Industry	857,81	5,34	356,25	NO	NO	NO	1 219,40
C. Metal Production	4 027,93	1,26	5,06	NO	205,08	0,00	4 239,33
D. Other Production	207,27						207,27
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				914,44	0,00	75,38	989,83
G. Other	52,24	NA	NA	NA,NO	NO	NO	52,24
3. Solvent and Other Product Use	**126,70**		**44,18**				**170,88**
4. Agriculture		**2 385,36**	**2 071,13**				**4 456,49**
A. Enteric Fermentation		2 068,35					2 068,35
B. Manure Management		314,66	150,94				465,60
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	1 919,51				1 919,51
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		2,35	0,68				3,02
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-23 602,32**	**1,62**	**22,67**				**-23 578,03**
A. Forest Land	-28 680,97	1,62	12,55				-28 666,79
B. Cropland	1 977,96	0,00	10,06				1 988,02
C. Grassland	100,31	0,00	0,00				100,31
D. Wetlands	-81,52	0,00	0,05				-81,47
E. Settlements	3 021,63	0,00	0,00				3 021,63
F. Other Land	48,22	0,00	0,00				48,22
G. Other	12,04	0,00	0,00				12,04
6. Waste	**0,00**	**1 091,24**	**136,77**				**1 228,01**
A. Solid Waste Disposal on Land	0,00	1 081,66					1 081,66
B. Waste-water Handling	0,00	9,51	136,70				146,21
C. Waste Incineration	0,00	0,07	0,07				0,14
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	54 317,25
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	30 739,22

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Inventory 2011
(Sheet 1 of 1)							Submission 2013 v1.1
							NORWAY
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 [1]**	**CH_4**	**N_2O**	**HFCs [2]**	**PFCs [2]**	**SF_6 [2]**	**Total**
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**17 055,23**	**4 397,65**	**3 101,74**	**950,21**	**225,73**	**60,72**	**25 791,27**
1. Energy	**38 404,29**	**973,30**	**453,21**				**39 830,81**
A. Fuel Combustion (Sectoral Approach)	35 774,16	348,50	449,90				36 572,55
1. Energy Industries	14 324,49	94,97	48,94				14 468,39
2. Manufacturing Industries and Construction	3 289,86	12,02	42,28				3 344,17
3. Transport	14 870,59	90,54	277,39				15 238,52
4. Other Sectors	3 047,04	148,67	76,96				3 272,67
5. Other	242,18	2,29	4,33				248,80
B. Fugitive Emissions from Fuels	2 630,13	624,81	3,32				3 258,26
1. Solid Fuels	5,08	38,92	0,00				44,00
2. Oil and Natural Gas	2 625,06	585,88	3,32				3 214,26
2. Industrial Processes	**6 110,26**	**6,34**	**293,81**	**950,21**	**225,73**	**60,72**	**7 647,07**
A. Mineral Products	1 005,13	0,00	0,00				1 005,13
B. Chemical Industry	819,46	5,18	289,34	NO	NO	NO	1 113,99
C. Metal Production	4 053,80	1,16	4,47	NO	225,73	0,00	4 285,16
D. Other Production	179,59						179,59
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				950,21	0,00	60,72	1 010,93
G. Other	52,27	NA	NA	NA,NO	NO	NO	52,27
3. Solvent and Other Product Use	**136,51**		**44,04**				**180,55**
4. Agriculture		**2 336,06**	**2 148,47**				**4 484,53**
A. Enteric Fermentation		2 023,10					2 023,10
B. Manure Management		311,19	149,12				460,31
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		0,00	1 998,84				1 998,84
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		1,77	0,51				2,29
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**-27 595,83**	**0,22**	**22,68**				**-27 572,93**
A. Forest Land	-32 379,79	0,22	12,48				-32 367,09
B. Cropland	1 923,72	0,00	10,15				1 933,87
C. Grassland	175,52	0,00	0,00				175,52
D. Wetlands	-83,29	0,00	0,05				-83,23
E. Settlements	2 704,28	0,00	0,00				2 704,28
F. Other Land	46,95	0,00	0,00				46,95
G. Other	16,78	0,00	0,00				16,78
6. Waste	**0,00**	**1 081,73**	**139,52**				**1 221,25**
A. Solid Waste Disposal on Land	0,00	1 071,98					1 071,98
B. Waste-water Handling	0,00	9,70	139,44				149,14
C. Waste Incineration	0,00	0,06	0,07				0,13
D. Other	NA,NO	NA,NO	NA,NO				0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO_2 Emissions from Biomass							

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	53 364,20
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	25 791,27

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

Annex VII: Harvested wood products

1. Description

In the currently valid accounting system, emissions of CO_2 from harvested wood products (HWP) are attributed to the year of harvest and to the country where the harvest occurred. The default approach is ‘’based on the perception that HWP stocks are not changing. That is, the annual carbon inflow and outflow for the HWP reservoir were assumed to be equal and the oxidation from pre-existing wood products stocks could be replaced (and hence omitted) by an implied oxidation directly after harvesting. More precisely therefore the IPCC default assumption was that inputs to the HWP reservoir equals outputs’’ (IPCC 2006). If more wood is stored than oxidised in a given year, HWP will act as a sink and a removal of CO_2 is recorded. However, if the consumption of wood decreases to a level below what is oxidised, HWP will act as a source and emissions of CO_2 is recorded.

In Norway, as in many other countries, the stock of HWP has been increasing for many years, and is likely to increase further.

2. Methodological issues

There are several approaches and methods/models for estimating changes in the HWP pool. The approaches describe how emissions are allocated to countries, depending on production, imports and exports of HWP. Estimation methods/models, on the other hand, are how the emissions and HWP stocks are estimated from national data and statistics.

In Bache-Andreassen (2009) five approaches were investigated; the stock change approach, the atmospheric flow approach, the production approach, the simple decay approach and the stock change approach for HWP of domestic origin. In the 2010 and 2011 NIR submissions, emissions/removals of CO_2 due to harvested wood products were estimated using the *stock change approach* (SCA). However, due to the Durban decision not to include imported wood products (Decision 2/CMP.7), the SCA approach could no longer be used and was thus replace in the 2012 submission by the *production approach* (PA) for the reporting to the UNFCCC. Due to the revision last year and the on-going work on new IPCC guidance for HWP, we continued to use the PA in the current 2013 submission.

In the PA all domestically harvested wood is accounted for, including the amount that is exported. The exported HWP will thus remain in the inventory reported by the exporting country. The exporting country will therefore include the exported wood residing in other countries in its reporting, while imported wood thus does not need to be accounted for. This is in accordance with the Durban decision.

Inflow to HWP from domestic harvest ($\Delta C_{HWP\ IU\ DH}$)

The inflow to HWP products produced annually from domestic harvest is estimated by:

$$Inflow_{DH} = P \bullet \left[\frac{IRW_H}{IRW_H + IRW_{IM} - IRW_{EX} + WCH_{IM} - WCH_{EX} + WR_{IM} - WR_{EX}} \right]$$

Where:

$Inflow_{DH}$ = Carbon in annual consumption of solid wood or paper products that came from wood harvested domestically [Gg C yr^{-1}]

P = Carbon in annual production of solid wood or paper products [Gg C yr^{-1}]

IRW_H = Industrial roundwood harvest. This is the harvest of wood to make solid wood and paper products including IRW for export [Gg C yr^{-1}]

IRW_{IM} = Industrial roundwood imports [Gg C yr^{-1}]

IRW_{EX} = Industrial roundwood exports [Gg C yr^{-1}]

WCH_{IM} = Wood chip imports [Gg C yr^{-1}]

WCH_{EX} = Wood chip exports [Gg C yr^{-1}]

WR_{IM} = Wood residues from wood products mills imports [Gg C yr^{-1}]

WR_{EX} = Wood residues from wood products mills exports [Gg C yr^{-1}]

Note that even though imported harvested wood products are not included among the sinks/sources, import figures are used to estimate the correct amount of the wood products that are based on domestically harvested wood.

Emissions/removals of CO_2 due to harvested wood products, are estimated using the IPCC HWP model (IPCC 2006). The IPCC HWP model (Tier 1) is a flux method with a life-time analysis. Activity data on production, imports and exports of semi-finished wood products are required together with estimates on the lifetimes of the different products. As there is no easy way to know the fate of exported HWP, it is assumed in the estimation model that exported HWP is used in the same manner as if it were in domestic use.

In Durban it was also decided that harvested wood products resulting from deforestation shall be accounted for on the basis of instantaneous oxidation. The model has been adjusted so that wood harvesting resulting from deforestation can be left out of the removal estimates. We have statistics on deforestation rates back to 1990.We assume that the proportion of annual harvesting originating from deforested land equals to 3.3%. This corresponds to the historic mean based on data from NIR. We have further assumed the same rate for all products. We have made the same assumptions back to 1961. These assumptions are preliminary, and will be subject to further investigation.

3. Activity data and emission factors

Statistics on production, import and export of semi-finished wood products going back to 1960 are collected from the FAO statistical databases (FAO 2013), see Table A7-1.

Table A7-1: Activity data for the commodities from the FAO statistical databases (FAO 2013) shown below are needed in the calculations. The activity data is needed for all years going back to 1960.

	Production	Imports	Exports
Sawn wood	X		
Wood-based panels	X		
Industrial roundwood	X	X	X
Wood residues		X	X
Chips and particles		X	X
Paper and paperboard	X		

In addition to the FAO activity data, a set of lifetimes, conversion factors and growth rate of HWP prior to 1960 is needed in order to estimate the HWP contribution. Default values for all the factors are provided in the 2006 IPCC guidelines. Whenever possible, national values have been estimated for available statistical data and employed instead of the default values, turning the model into a Tier 2 method.

The half-lives used in the calculations are default values for the IPCC HWP model; two years for paper, 25 years for wood panels and 35 years for sawn wood. The half-lives are assumed to be constant for the entire period included in the model. The same half-lives were used for products consumed domestically as for products consumed by importing countries.

The conversion factors used in the calculations are based on expert judgements by Fjulsrud and Bunkholt (pers. comm. 2009), see Table A7-2.

Table A7-2: Half-lives and conversion factors, given by the IPCC (2006).

Half lives	**Value**	**Unit**
Sawn wood products	35	years
Wood-based panels products	25	years
Paper products	2	years
Conversion factors		
Sawnwood, Oth.Ind.rw	0.198	t C/m3
Wood-based panels	0.294	t C/m3
Paper products	0.45	t C/adt
Charcoal	0.765	t C/adt
Bark	1.17	C overb/C underb
Deforestation fraction	3.3	%
Estimated growth rate of HWP consumption prior to 1961	0.90	% per year

HWP in landfills is not included in the estimates. Including it may give incentives for storing HWP in landfills. Landfills would be in contradiction with the regulative from the Ministry of the Environment which came into force July 1st 2009 (Ministry of the Environment 2008) concerning a prohibition on landfilling of biodegradable waste. If all wood and paper delivered to landfills are to be burned for bio energy, the annual change in carbon stock will decrease until it reaches zero (or close to zero).

4. Results

Estimated emissions reported by using PA and IPCC default model and country specific conversion factors are shown in Table A7-3. Note that negative emissions are referred to as removals. We can see that the emissions/removals of CO_2 due to HWP has varied between emissions of 54 Gg tonnes CO_2eq and removals of 1 363 Gg tonnes CO_2eq in the reporting period. The removals in 2011 has been estimated at 317 Gg tonnes CO_2eq, which represents about 1.15% of the total net sink in the LULUCF sector.

Table A7-3: HWP Contribution by using the product approach and the IPCC model.

Year	Gg CO_2 /year
1990	-1 363
1991	-1 090
1992	-853
1993	-1 008
1994	-445
1995	-106
1996	-338
1997	-352
1998	-169
1999	-287
2000	-130
2001	-162
2002	-79
2003	54
2004	-24
2005	-184
2006	-558
2007	-363
2008	-268
2009	-118
2010	-338
2011	-317

5. Uncertainties

PA will always be associated with higher uncertainties than the other approaches, since the estimates of the fate of exported HWP are highly uncertain (Bache-Andreassen 2009). The highest uncertainty in the IPCC HWP model is connected to the lifetime assumption and is about 50 present (IPCC 2006).

6. Recalculations

In the 2013 submission we continued using the PA approach, and there are no plans for any new recalculations before the new IPCC guidance on HWP for the second commitment period is approved.

7. Planned improvements

In light of the current process of providing new IPCC guidance for the second commitment period, Norway will wait implementing any improvements until the guidance is finalized. However, Norway plans to 1) look into ways to provide country specific data on emissions factors in order to use a Tier 3 method, and 2) work on improvements regarding the assumptions on deforestation rates.

8. References

Bache-Andreassen, L. (2009): *Harvested wood products in the context of climate change – A comparison of different models and approaches for the Norwegian greenhouse gas inventory*, Reports Statistics Norway

FAO (2012): *Food and Agriculture Organization of the United Nations. Statistical Databases. FAOSTAT Forestry*. http://faostat.fao.org., Last accessed February 22, 2013,

Fjulsrud K.E. & Bunkholt Aa. (2009): *Personal communication*. Norwegian Sawmill Industries Association and Wood Focus Norway.

Flugsrud K., Hoem B., Kvingedal E. & Rypdal K. (2001): *Estimating the net emissions of CO_2 from harvested wood products; A comparison between different approaches*. SFT Report 1831:2001.

Gjesdal S.F.T., Flugsrud K., Mykkelbost T.C. & Rypdal K. (1996): *A balance of use of wood products in Norway*. SFT Report 96:04.

IPCC (1996): *1996 IPCC Guidelines for National Greenhose Gas Inventories*. http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html.

IPCC (2006): *Chapter 12. Harwested Wood Products + HWP Worksheet MS Excel (V4_12_Ch12_HWP_Worksheet.xls)*. In: *2006 IPCC Guidelines for National Greenhose Gas Inventories* (Pingoud K., Skog K.E., Martino D.L., Tonosaki M., Xiaoquan Z. & Ford-Robertson J.). http://www.ipcc-nggip.iges.or.jp/public/2006gl

Kyoto protocol (1997). http://unfccc.int/kyoto_protocol/items/2830.php

Ministry of the Environment (2008). http://www.regjeringen.no/en/dep/md/press-centre/Press-releases/2008/forbud-mot-deponering-av-nedbrytbart-avf.html?id=520348

Annex VIII: SEF and Registry Changes

Annex VIII consist of the files:

1. Version_Change_Management_v1.1.pdf
2. Time_Validation_Plan_v1.1.pdf
3. Security_Plan_v1.1.pdf
4. Roles_And_Responsibilities_v.1.1.pdf
5. Operational_Plan_v.1.1.pdf
6. Manual_Intervention_v1.1.pdf
7. Disaster_Recovery_v.1.1.pdf
8. Change_Management_Plan_v1.1.pdf
9. Application_Logging_Plan_v.1.1.pdf
10. SEF_NO_2013_1_16-40-27 12-3-2013

The files listed in 1. to 9. contain sensitive information on the registry and should not be made publicly available.

- For each plant; a first time series of emission data as well as activity data were established with basis on existing sources of data (see section on data sources).

- The first time series of emission data and activity data were presented in both a table format as well as a graphic presentation.

- Based on the table with compiled data and the graphic presentation, it was possible to identify:
    - Lack of emission data and activity data for any year or time series.
    - Possible errors in the reported data. Possible errors were typically identified if there were discrepancies between reported activity data (consumption of raw materials, production volumes etc.) and emissions, or if there were large variations in the existing time series of emissions.

- The emission data where supplemented and/or corrected if possible by one or more of the following sources of information:
    - Supply of new data from the company
    - Supplementary data from Klif paper archives.
    - Verification of reported emission data by new calculations based on reported activity data.
    - Calculation of missing emissions (if sufficient activity data were present).

- A final time series of greenhouse gas emissions from 1990 to 2004 were established, and presented both as a tables and a figure. The origin of the data was documented by the use of colour codes.

- The differences between former and new time series of emissions were identified and documented.

3. Data sources for the data series of emissions 1990-2004

There were six main sources of final data to the time series: the Inkosys (today's Forurensning) database, the white books on GHG, new data calculated by Klif based on reported activity data, new data provided by company, and new data based on interpolation between years. Interpolation was typically used as a method to establish data for the year 1991, if the emissions from 1990 and 1992 were given.

<u>The Inkosys Database (today's Forurensning)</u>
Data from the annual company emission reports were stored in the Klif database Inkosys.
The database contained data from 1992, and held emission and activity data from all companies reporting emissions to Klif. The Inkosys database held reported emissions and activity data from Norwegian companies. The companies reported the data according to a manual (SFT, 2004). In Klif, the respective responsible officer in the State Pollution Control Authority undertook a control of the data, before they were inserted in the database.

The white book on GHG from Norwegian process industry

The white book on GHG from Norwegian process industry was initiated by the Federation of Norwegian Process industry (PIL), Norwegian Chemical Industrial Worker's Union (NKIF) and Norwegian Oil- and Petrochemical Worker`s Union (NOPEF). The work was carried out by DNV and Sintef, who collected, compiled, controlled and verified all emissions of climate gasses from these industrial plants for the years 1990, 1998, 1999, 2000 and 2001. The methods of work as well as the main results are described in the report from this project (Federation of Norwegian Process Industry 2003). The main data files and verification tables from this work have been made available for the State Pollution Control Authority. The white book includes data from 60 process industry plants.

Since the emission data in this white book has gone through a thorough verification process, these emissions were assumed to be correct, unless any other information proved them incorrect. If several data sources reported different series of emissions, the data series from the white book were used.

The white book on GHG from Norwegian pulp and paper industry

The white book on GHG from Norwegian pulp and paper industry work was initiated by the Norwegian Pulp and Paper Association, and was carried out by DNV, Sintef and the Norwegian Association of Energy Users and Suppliers. They collected, compiled, controlled and verified all emissions of climate gasses from the relevant pulp and paper plants for the years 1990, 1998, 1999, 2000 and 2001. The methods of work as well as the main results are described in the reports from this project (Norwegian Pulp and Paper Association 2003). The main data files from this work have been made available for the State Pollution Control Authority.

Since the emission data in this white book has gone through a thorough verification process, these emissions were assumed to be correct, unless any other information proved them incorrect. If several data sources reported different series of emissions, the data series from the white book were used.

Other sources

Other data sources also available for this work were:

- Annual update of the climate gas inventories based on annual reports from Norwegian industry. Reported to Statistics Norway.
- Annual (paper) reports from industry of emission to air, water and soil (Egenrapportering).
- Applications for CO_2-permits for the Norwegian emissions trading scheme.

4. Documentation of calculations and time series 1990-2004

The main documentation from the work is contained in Excel spread sheets giving the resulting time series for each plant included in this revision. Each spread sheet includes emission data and activity data from the relevant data sources for each production plant. It includes the time series for the relevant greenhouse gases, and states the sources for this information. Relevant information related to the QA/QC process for the specific site is noted as a comment or as a text box for each plant.

5. Current QA/QC procedures and data sources.

There have been some changes in the QA/QC for plant specific emissions in the process industry since the QA/QC exercise undertaken in 2006. In addition the same QA/QC exercise is undertaken for plant specific data included in the inventory in the Energy sector (Energy Industries, Manufacturing Industries and Construction and Fugitive Emissions from Fules – Oil and Natural Gas). The inventory compilers in Klif have more data sources for each plant as all plants submit annual reports electronically as required by their regular permit, some are also covered by the EU emission trading systems (EU ETS) and some are also covered by a voluntary agreement. The most important changes since 2006 are and described below.

5.1 Documentation of calculations and time series

The main documentation from the work is still contained in Excel spread sheets. The emission reports from the enterprises are submitted in a standardized electronic format directly to the Climate and Pollution Agency by 1 March each year. The EU ETS reports are thoroughly checked by the Climate and Pollution Agency by the Department of Climate, while the Department of Industry is in charge of checking the reports submitted due to regular permits. The agency has personnel with extensive technical competence in the relevant industry processes. For EU ETS, Klif may also require third-party verification of emission reports from installations with multiple and complex processes.

For the purpose of the inventory, additional QA is undertaken by the Section for Environmental Economics and Emission Inventories in the Climate and Pollution Agency before the data are sent to Statistics Norway. These QA checks include consideration of time-series consistency, inter-annual changes and more attention is now given to implied emission factors (IEF). When needed, further QC is undertaken in collaboration with the officer in Klif in charge for the specific plant and/or the plant. New plants and a new sector (gas-fired power plants) have been included. Time series are continuously recalculated if better data/information is gained.

The use of EU ETS data and data from the voluntary agreement does not represent a problem for the time series consistency. This is because the Norwegian GHG inventory for a long time (since the early 90ies) has included GHG emissions from industrial point sources (both emissions from processes and combustion). The new data sources provide data of better quality and these are checked against the emissions reported under the regular permits.

5.2 Data from the EU ETS

The GHG inventory now includes more reported data from the emission trading systems (ETS) for the periods 2005-2007 and 2008-2012. In this period the ETS mainly covers emissions from energy combustion with som exceptions. The ETS scheme for the period 2008-2012 is linked with the EU emission trading scheme. This has led to that the reporting requirements are stricter than before and QC is even more detailed. The decisions of approvals of the reports, applications for permits, the permits, the plans for measuring and reporting, the emission reports and approvals are all available to the public.

Before the plants are entitled to be a part of the ETS, they must have a permit for the emissions. The enterprises operating the plants must also have a Plan for measuring and reporting. This must be prepared according to the EU Measuring and Reporting Guidelines (MRG). Klif approves this plan, if we find it of high enough quality and it is consistent with the MRG and the Norwegian Guidance document. The operators must then perform their measurements and calculations according to this plan, and report according to that. Klif will control and verify the reports on greenhouse gas emissions submitted by each operator pursuant. Verification of an emissions report is an individual decision pursuant to the Public Administration Act.

In Norway, the plants covered by the EU ETS are divided into 3 categories (A, B and C), depending on their emissions:

Category A installations covers installations with average reported annual emissions over the previous trading period equal to or less than 50 kilotonnes of fossil CO_2 before subtraction of transferred CO_2

Category B installations covers installations with average reported annual emissions over the previous trading period of greater than 50 kilotonnes and equal to or less than 500 kilotonnes of fossil CO_2 before subtraction of transferred CO_2 and,

Category C installations covers installations with average reported annual emissions over the previous trading period of greater than 500 kilotonnes of fossil CO_2 before subtraction of transferred CO_2.

The MRG[1]'s tiers of approaches apply for all installations in the EU ETS (the 25 EU countries and Norway and Lichtenstein). They are described below:

The activity-specific guidelines set out in Annexes II to XI (of the MRG) contain specific methodologies for determining the following variables: activity data (consisting of the two variables fuel/material flow and net calorific value), emission factors, composition data, oxidation and conversion factors. These different approaches are referred to as tiers. The increasing numbering of tiers from one upwards reflects increasing levels of accuracy, with the highest numbered tier as the preferred tier.

The operator may apply different approved tier levels to the different variables fuel/material flow, net calorific value, emission factors, composition data, oxidation or conversion factors used within a single calculation. The choice of tiers shall be subject to approval by the competent authority (in Norway, The Climate and Pollution Agency). Equivalent tiers are referred to with the same tier number and a specific alphabetic character (e.g. Tier 2a and 2b). For those activities where alternative calculation methods are provided within these guidelines (e.g. in Annex VII, 'Method A — kiln input based' and 'Method B — clinker output based') an operator may only change from one

[1] See http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32007D0589:EN:NOT for current MRG in several languages.

method to the other if he can demonstrate to the satisfaction of the competent authority that such change will lead to a more accurate monitoring and reporting of the emissions of the relevant activity.

The highest tier approach shall be used by all operators to determine all variables for all source streams for all category B or C installations. Only if it is shown to the satisfaction of the competent authority that the highest tier approach is technically not feasible or will lead to unreasonably high costs, may a next lower tier be used for that variable within a monitoring methodology.

Norway has transposed the MRG into national law[2] and has developed a guidance document.[3]

All the decisions of approvals of the reports for the period 2008-2012 are posted on Klif's web site.[4] Also note that all documentation like applications for permits, the permits, the plans for measuring and reporting, the emission reports and approvals are all available to the public.

Data for some important sectors have been reviewed as part of the reviews performed at Klif. However, the EU ETS has introduced a new reporting channel with its own, more specific, energy data. This has made it apparent that for some facilities, the reported emissions do not correspond fully to the energy data reported to SN. This is one of the reasons that SN is introducing a new check in the current inventory cycle. The total emissions from a facility will be compared to emissions calculated from data reported to the energy statistics together with default emission factors. If deviations are found, the comparison will be made at the level of fuel types. The tolerances for allowed differences are to be decided, as we don't know yet the magnitude of the potential deviations.

The differences between the energy data in the EU ETS and SN that has been identified typically refers to emissions from fuel streams in chemical industries and gas processing units that are derived from raw materials. These often have deviating, plant specific emission factors and energy contents, and in some cases they are reported as raw materials use to the energy statistics.

5.3 Data from the voluntary agreement

The first voluntary agreement between industry and authorities came in place in 1997 and included the aluminium production.

[2] http://www.regjeringen.no/en/doc/Laws/Acts/Greenhouse-Gas-Emission-Trading-Act.html?id=172242
[3] http://www.sft.no/publikasjoner/2301/ta2301.pdf
[4] http://www.klif.no/Tema/Klima-og-ozon/CO2-kvoter/Klimakvoter-for-2008/

The most sector comprehensive agreement came in 2005 and covered all carbon-intensive industries that were not included in the ETS in 2005-2007 or 2008-. The most important sectors that report or have reported under the voluntary agreement are production of aluminium, ferroalloys, anodes, ammonia, nitric acid and oil refineries and gas terminals. Separate and detailed rules for calculation of emissions and for reporting from industries that is part of the voluntary agreement are developed. A common reporting template is used and a guidance document is available [i] (only in Norwegian). This has led to that the reporting requirements are stricter than before and QC performed by the inventory compilers in Klif before handing over the data to SN is as described in section 5.1. The required methodology for estimating emissions in the voluntary agreement from 2005 is from our judgement consistent with methodologies described in ETS 2008-2012 and the ETS from 2013.

5.4 The Forurensing database

The Inkosys database has been replaced by the "Forurensing" database which was presented to the ERT during the in-country review of the 2012 NIR. All the data from Inkosys has been transferred to Forurensing. The Forurensing database includes the data and information reported by the plants under their regular permit and data as reported under the EU ETS. The database eases the work of the inventory compilers at Klif as a lot of data is easily available. Specific queries can be tailored for withdrawal of data from the database.

5.5 The Norwegian Pollutant Release and Transfer Register (PRTR).

In addition to posting data and information from the EU ETS on Klif's web page, other data is also made publically available. Data from the plants as reported under their regular permit can be accessed through the Norwegian Pollutant Release and Transfer Register (PRTR).[5] The Norwegian PRTR website provides information about discharges to air and water, waste transfers, production volumes and energy use for the most of the emission sources in Norway. The website includes both point sources and diffuse emissions.

5.6 Inspections

The Climate and Pollution Agency has a separate Department of Control and Water, which consists of three sections for product and industrial control. This department is working independently from the department evaluating emissions permits. They inspect and monitor industrial sites/plants, including underlying documentation for the emission estimates. The Department is part of the CPA and its tasks are described in the National System and it is hence considered a part of the inventory system.

The department has extensive competence and experience in performing audits and inspections. They also have technical expertise in industrial processes and offshore oil and gas production. There is exchange of knowledge and experience between the experts on the ETS and this department. The department has regular training courses for the inspectors, where the regulations they shall audit after is an important element. Particular controls are directed to the plants included in the emission

[5] See http://www.norskeutslipp.no/Templates/NorskeUtslipp/Pages/sektor.aspx?id=1106&epslanguage=en for the English version.

trading system to check that reported emissions are in line with the requirements in the emission trading regulation. All plants are to be controlled once over a period of three years. These controls have focused on the plant's implementation of the reporting requirements. Deficiencies are met with stringent requests for improvements.

In their applications for permits, the plants describe their internal Quality Control Systems. It is a requirement in the permits that they apply and operate this system. This is one of the areas that the Department of Control and Water carefully controls when they carry out inspections and audits at the facilities.

5.7 Guidance documents

During the review process of the NIR submitted in 2012, Norway informed the ERT that the guidelines for measuring within the emissions trading system, the voluntary agreement between the industry and the authority and the guidelines for reporting that all plants with a permit have to follow would be included in the 2013 annual submission. The guidance documents are lengthy and in Norwegian, so instead of attaching these to the NIR URLs are provided below.

EU ETS:
http://www.klif.no/no/Tema/Klima-og-ozon/CO2-kvoter/--MENY/Skjema-og-innrapportering/

Environmental web (offshore activities)
http://www.google.no/url?sa=t&rct=j&q=veiledning%20til%20den%20%C3%A5rlige%20utslippsrapporteringen%20olf%202007&source=web&cd=1&ved=0CC0QFjAA&url=http%3A%2F%2Fwww.norskoljeoggass.no%2FPageFiles%2F6542%2FVeiledning%2520til%2520utslippsrapportering%25202009.pdf&ei=qLleUZPBEInK4ATpnYCYBw&usg=AFQjCNH_gQhyHemDnyAMv7TlblmwSIP25g&bvm=bv.44770516,d.bGE

Annual normal permit:
www.klif.no/publikasjoner/3012/ta3012.pdf

[i] Voluntary agreement:
http://www.klif.no/skjema/Regler%20for%20beregning%20og%20måling%20av%20klimagassutslipp%20fra%20avtalebedriftene.pdf

Annex X: Agriculture

X.1 Animal population data

X1.1 Animal population data used for calculating 4A tier 2 CH_4 emissions from enteric fermentation from cattle and sheep and for the 4B and 4D N_2O calculations

Animal population data used for calculating 4A tier 2 CH_4 emissions from enteric fermentation from cattle and sheep and for the 4B and 4D N_2O calculations are given in the CRF. Disaggregated data used for 4A cattle are given in Section 6.2.3, table 6.2.

X1.2 Animal population data used for 4A tier 1 calculation of CH_4 from enteric fermentation and 4B CH_4 from manure management

The animal population data used for 4A tier 1 calculation of CH_4 from enteric fermentation and 4B CH_4 from manure management differ to some extent from the animal population data reported in the CRF. The reason for this is the following: Parts of the inventory (estimations of N_2O from manure (4B) and CH_4 from enteric fermentation from cattle (4A1 and 4A2) was improved and this required a new set of activity data (animal numbers). In the parts of the inventory that was not improved, the old set of animal data was maintained. This has resulted in different sets of animal data in the various estimations (see Recalculation Chapter 9.2.4 for more information about the difference in the two sets of animal population data). In the CRF, only the new set of animal numbers is reported. This inconsistency in animal numbers will be resolved in the next inventory.

In table AX-1 animal population used for estimating CH_4 from enteric fermentation (tier 1) and CH_4 from manure management are given.

The main differences in the population data in table AX-1 from the animal population data given in the CRF is the following:

- Changed data source for mature dairy cattle
- Changed data source for young cattle (all categories)
- Changed data source for mature non-dairy cattle (all categories). Suckler cows have been reallocated from "mature dairy cattle" to "mature non-dairy cattle".
- Changed data source for pigs for slaughter
- Pigs > 6 months has been divided in sows and pigs for breeding
- Changed data source for poultry for slaughter (chicken, duck, turkey)
- Chicks bred for laying hens (number of stall insertions per year are changed)

There might also be some minor changes in population data for other categories.

Table AX-1. Animal population data used for 4A tier 1 calculation of CH_4 from enteric fermentation and 4B CH_4 from manure management

		1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
4A Enteric Fermentation	Goats	85126	84871	84643	83921	82745	81868	80735
4A Enteric Fermentation	Horses	31430	32988	34345	35943	37373	38013	39382
4A Enteric Fermentation	Swine	533586	549838	575996	563207	562473	586765	622983
4A Enteric Fermentation, Poultry	Hens	2895663	3694943	3666601	3616583	3615625	3556841	3378714
4A Enteric Fermentation, Poultry	Chickens	6508259	6717531	6723682	6299338	6746370	6968490	7591841
44A Enteric Fermentation, Poultry	Duck	18230	19988	21991	31582	34255	22688	18492
4A Enteric Fermentation, Poultry	Turkeys	138730	159815	192161	278213	235185	310493	345905
4A Enteric Fermentation, Other	Ostrich	0	0	0	0	0	0	0
4A Enteric Fermentation, Other	Deer	0	0	0	0	0	0	0
4A Enteric Fermentation, Other	Reindeer	242443	226031	225533	217891	217868	212333	199620
4A Enteric Fermentation, Other	Fur- bearing animals	177643	185532	142723	159588	181159	184595	208298
4B Manure Management, Cattle	Dairy Cattle	342068	344429	342058	340087	338737	340929	345611
4B Manure Management, Cattle	Heifer<1år	178190	177686	178113	175795	175895	175527	177889
4B Manure Management, Cattle	Bull <1år	180005	179751	180979	179534	180856	182065	183739
4B Manure	Heifer >1år	173519	177178	177214	180243	177351	179353	181477

Management, Cattle								
4B Manure Management, Cattle	Bull >1år	104565	110308	111761	113063	115596	121798	125980
4B Manure Management, Sheep	Sheep < 1 år	519541	534781	550021	540422	576623	592999	596173
4B Manure Management, Sheep	Sheep > 1 år	1028867	1082391	1094910	1021346	1119823	1138821	1107716
4B Manure Management, Goats	Goats, dairy	64041	63987	62170	61624	59546	58630	57948
4B Manure Management, Goats	Goats, other	21085	20884	22473	22297	23199	23238	22787
4B Manure Management	Horses	31430	32988	34345	35943	37373	38013	39382
4B Manure Management, Swine	Pigs > 6 months	87776	90995	90340	86940	86855	90385	91567
4B Manure Management, Swine	Pigs for slaughter	445810	458843	485656	476267	475618	496380	531416
4B Manure Management, Poultry	Hens	2895663	3694943	3666601	3616583	3615625	3556841	3378714
4B Manure Management, Poultry	Chicks bred for laying hens	3459064	3463980	3358205	3158337	3151037	2984493	2938981
4B Manure Management, Poultry	Chicks for slaughtering	3049195	3253551	3365477	3141001	3595333	3983997	4652860
4B Manure Management, Poultry	Ducks for breeding	2326	2865	3550	2757	2852	4490	3478
4B Manure Management, Poultry	Ducks for slaughtering	15904	17123	18441	28824	31403	18198	15014

4B Manure Management, Poultry	Turkey/goose for breeding	13180	16235	20115	15625	16161	25441	19710
4B Manure Management, Poultry	Turkey/goose for slaughtering	125550	143580	172046	262588	219024	285052	326195
4B Manure Management, Other	Ostrich	0	0	0	0	0	0	0
4B Manure Management, Other	Deer	0	0	0	0	0	0	0
4B Manure Management, Other	Reindeer	242443	226031	225533	217891	217868	212333	199620
4B Manure Management, Other	Mink, male	7635	7492	5667	6460	6613	5982	6957
4B Manure Management, Other	Mink, female	53442	52442	39668	45220	46292	41873	48698
4B Manure Management, Other	Foxes, male	19428	20933	16231	17985	21376	22790	25441
4B Manure Management, Other	Foxes, female	97139	104665	81157	89923	106878	113950	127203

		1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
4A Enteric Fermentation	Goats	78079	75612	73998	72504	69719	66591	67084
4A Enteric Fermentation	Horses	40497	42747	44358	48299	49429	48945	50319
4A Enteric Fermentation	Swine	628439	640775	629965	608653	605875	632193	624694
4A Enteric Fermentation, Poultry	Hens	3117278	3124095	3144497	3228812	3064785	3082000	3214509
4A Enteric Fermentation,	Chickens	7680301	7823295	7711223	8817885	8317420	9567402	9587746

Poultry								
44A Enteric Fermentation, Poultry	Duck	19793	23260	28312	32931	55956	40135	28329
4A Enteric Fermentation, Poultry	Turkeys	273694	260088	248648	266053	287358	317384	367653
4A Enteric Fermentation, Other	Ostrich	0	1335	2113	1923	1288	537	328
4A Enteric Fermentation, Other	Deer	0	966	3526	5096	6268	5355	5411
4A Enteric Fermentation, Other	Reindeer	201498	187436	187967	172407	168288	191838	210075
4A Enteric Fermentation, Other	Fur- bearing animals	197581	162892	142168	170647	173143	169902	165981
4B Manure Management, Cattle	Dairy Cattle	345727	349410	347362	341763	328199	316072	319872
4B Manure Management, Cattle	Heifer<1år	179485	181567	174477	171818	163408	156535	157608
4B Manure Management, Cattle	Bull <1år	187272	189005	180013	172171	167404	160363	161462
4B Manure Management, Cattle	Heifer >1år	185585	188120	192142	189994	182027	174371	175566
4B Manure Management, Cattle	Bull >1år	127484	130299	121864	110606	110850	106188	106916
4B Manure Management, Sheep	Sheep < 1 år	568317	546808	622551	639746	654334	641394	668572
4B Manure Management, Sheep	Sheep > 1 år	1076217	1100478	1102068	1129458	1138073	1104909	1111513
4B Manure Management, Goats	Goats, dairy	55436	53431	51847	50578	47364	45381	45196
4B Manure	Goats, other	22643	22181	22151	21926	22355	21210	21888

Management, Goats								
4B Manure Management	Horses	40497	42747	44358	48299	49429	48945	50319
4B Manure Management, Swine	Pigs > 6 months	90356	89398	96050	89976	88847	88471	95426
4B Manure Management, Swine	Pigs for slaughter	538083	551377	533915	518677	517028	543722	529268
4B Manure Management, Poultry	Hens	3117278	3124095	3144497	3228812	3064785	3082000	3214509
4B Manure Management, Poultry	Chicks bred for laying hens	3016345	3152180	2206468	2184479	1896439	2460805	2246683
4B Manure Management, Poultry	Chicks for slaughtering	4663956	4671115	5504755	6633406	6420981	7106597	7341063
4B Manure Management, Poultry	Ducks for breeding	2875	1895	3163	3044	4143	6706	5386
4B Manure Management, Poultry	Ducks for slaughtering	16918	21366	25149	29888	51813	33430	22943
4B Manure Management, Poultry	Turkey/goose for breeding	16293	10736	17925	17248	23477	37999	30518
4B Manure Management, Poultry	Turkey/goose for slaughtering	257401	249351	230723	248804	263881	279385	337134
4B Manure Management, Other	Ostrich	0	1335	2113	1923	1288	537	328
4B Manure Management, Other	Deer	0	966	3526	5096	6268	5355	5411
4B Manure Management, Other	Reindeer	201498	187436	187967	172407	168288	191838	210075

4B Manure Management, Other	Mink, male	7578	7292	7679	9274	9475	9757	9274
4B Manure Management, Other	Mink, female	53049	51045	53756	64919	66325	68299	64916
4B Manure Management, Other	Foxes, male	22826	17426	13455	16076	16224	15308	15299
4B Manure Management, Other	Foxes, female	114128	87129	67277	80378	81119	76538	76493

		2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
4A Enteric Fermentation	Goats	65957	68898	66226	66885	65538	64389	62807	62768
4A Enteric Fermentation	Horses	51984	55355	56257	61454	63907	65817	66752	67155
4A Enteric Fermentation	Swine	668485	674237	680519	675091	692279	703554	715262	707401
4A Enteric Fermentation, Poultry	Hens	3419760	3343410	3302308	3546749	3737506	3964962	3945607	3877138
4A Enteric Fermentation, Poultry	Chickens	11030215	11421971	11947049	12910310	14477484	14614066	14724433	14407781
44A Enteric Fermentation, Poultry	Duck	31332	34562	45608	61159	64473	55654	51861	62741
4A Enteric Fermentation, Poultry	Turkeys	440117	410903	376174	435600	513990	559557	459030	452166
4A Enteric Fermentation, Other	Ostrich	192	143	81	50	41	26	22	48
4A Enteric Fermentation, Other	Deer	6022	8289	9638	9652	11388	7911	8364	9075
4A Enteric Fermentation,	Reindeer	232838	234608	233160	243251	253721	248522	253400	246056

Other									
4A Enteric Fermentation, Other	Fur- bearing animals	179738	192299	211438	208143	191553	169887	172004	184671
4B Manure Management, Cattle	Dairy Cattle	316226	320901	308152	315336	309284	306122	306781	303144
4B Manure Management, Cattle	Heifer<1år	157175	158762	151495	152700	150306	148270	146788	144422
4B Manure Management, Cattle	Bull <1år	161019	162645	155200	156434	153982	151896	150377	147954
4B Manure Management, Cattle	Heifer >1år	175084	176852	168757	170099	167432	165164	163513	160878
4B Manure Management, Cattle	Bull >1år	106622	107698	102769	103586	101962	100581	99575	97971
4B Manure Management, Sheep	Sheep < 1 år	477713	467648	466899	448634	447373	464270	461592	480506
4B Manure Management, Sheep	Sheep > 1 år	1083216	1057911	1002006	1019998	1035624	1061636	1054092	1050191
4B Manure Management, Goats	Goats, dairy	44103	44374	41069	39721	38146	37427	35706	34783
4B Manure Management, Goats	Goats, other	21854	24524	25157	27164	27392	26962	27101	27985
4B Manure Management	Horses	51984	55355	56257	61454	63907	65817	66752	67155
4B Manure Management, Swine	Pigs > 6 months	97893	100813	98331	97624	99515	101563	98100	96345
4B Manure Management, Swine	Pigs for slaughter	570592	573424	582188	577467	592764	601991	617162	611056
4B Manure	Hens	3419760	3343410	3302308	3546749	3737506	3964962	3945607	3877138

Management, Poultry									
4B Manure Management, Poultry	Chicks bred for laying hens	3078379	3066358	2656524	2777021	2575518	3407622	2777268	2426312
4B Manure Management, Poultry	Chicks for slaughtering	7951836	8355613	9290525	10133289	11901966	11206444	11947165	11981469
4B Manure Management, Poultry	Ducks for breeding	5468	6807	6735	10808	9673	3278	5535	2233
4B Manure Management, Poultry	Ducks for slaughtering	25864	27755	38873	50350	54800	52376	46326	60508
4B Manure Management, Poultry	Turkey/goose for breeding	30988	38571	38167	61248	54813	18573	31366	12656
4B Manure Management, Poultry	Turkey/goose for slaughtering	409129	372332	338007	374353	459177	540985	427664	439510
4B Manure Management, Other	Ostrich	192	143	81	50	41	26	22	48
4B Manure Management, Other	Deer	6022	8289	9638	9652	11388	7911	8364	9075
4B Manure Management, Other	Reindeer	232838	234608	233160	243251	253721	248522	253400	246056
4B Manure Management, Other	Mink, male	11171	13297	15913	16357	15638	14209	14614	16206
4B Manure Management, Other	Mink, female	78194	93076	111393	114498	109468	99462	102297	113439
4B Manure Management, Other	Foxes, male	15062	14321	14022	12881	11074	9369	9182	9171
4B Manure Management,	Foxes, female	75311	71605	70110	64407	55372	46847	45911	45855

Other									

X.2 Methane emissions from enteric fermentation in Norway's cattle and sheep population.

X2.1 GE and Y_m

Values for gross energy intake (GE) and CH_4 conversion rate (Y_m) used in the tier 2 CH_4 emissions from enteric fermentation from cattle and sheep are given in Table AX-2.

Table AX-2 GE and Ym used for the respective animals at the subcategory level. 1990-2011

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Mature Dairy Cattle	Average GE (MJ/head/day)	292.26	289.39	289.62	291.50	289.70	287.97	286.18	283.64	282.80	281.16	278.26
	Ym (%)	7.37	7.42	7.40	7.42	7.46	7.48	7.51	7.55	7.56	7.59	7.65
Mature Non-Dairy Cattle	Average GE (MJ/head/day)	118.22	118.15	118.87	119.74	122.36	122.75	123.21	124.25	125.65	126.24	123.79
	Ym (%)	10.22	10.22	10.21	10.20	10.17	10.17	10.16	10.15	10.13	10.11	10.14
Young cattle	Average GE (MJ/head/day)	55.95	55.79	56.65	58.03	60.44	60.19	60.45	61.40	62.71	65.30	64.05
	Ym (%)	12.30	12.31	12.26	12.19	12.08	12.09	12.08	12.04	11.97	11.83	11.89
Sheep	Average GE (MJ/head/day)	45.95	45.85	45.90	46.08	45.97	45.98	46.11	46.06	45.88	46.02	45.98
	Ym (%)	5.24	5.26	5.25	5.21	5.24	5.24	5.21	5.22	5.26	5.24	5.25

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Mature Dairy Cattle	Average GE (MJ/head/day)	277.48	278.93	280.76	283.05	283.82	283.85	286.94	288.65	287.31	287.85	285.78
	Ym (%)	7.66	7.65	7.62	7.58	7.57	7.56	7.51	7.48	7.51	7.50	7.52
Mature Non-Dairy Cattle	Average GE (MJ/head/day)	123.23	123.74	124.94	125.77	127.92	127.89	129.26	129.88	132.18	132.05	131.36
	Ym (%)	10.16	10.16	10.14	10.13	10.10	10.10	10.08	10.07	10.03	10.04	10.04
Young cattle	Average GE (MJ/head/day)	61.96	62.40	63.18	63.92	66.46	66.50	68.57	69.23	71.73	71.51	71.36
	Ym (%)	12.00	11.98	11.95	11.91	11.78	11.78	11.68	11.64	11.52	11.53	11.54
Sheep	Average GE (MJ/head/day)	46.03	46.09	46.05	45.83	45.85	45.95	45.76	45.71	45.67	45.75	45.78
	Ym (%)	5.24	5.22	5.23	5.25	5.24	5.22	5.27	5.28	5.29	5.27	5.27

X2.2 Method description

By Harald Volden and Silje K. Nes, Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences.(2006).

Introduction

An important end product from the ruminal fermentation is methane (CH_4), and it is well known that the ruminants are important contributors to global warming through CH_4 production. The Norwegian calculation of CH_4 emission from livestock has been based on the Tier 1 method proposed by the Intergovernmental Panel on Climate Change (IPCC). However, the amount of CH_4 produced from enteric fermentation is dependent on several factors, like animal species, production level, quantity and quality of feed ingested and environmental conditions. Therefore, IPCC (IPCC 2001) has recommended to use more advanced methods when estimating CH_4 gas emission, which take into consideration the influencing factors described above. According to IPCC (IPCC 2001) the method for estimating CH_4 emission from enteric fermentation requires three basic items:

- No. 1 The livestock population must be divided into animal subgroups, which describe animal type and production level.
- No 2. Estimate the emission factors for each subgroup in terms of kilograms of CH_4 per animal per year.
- No 3. Multiply the subgroup emission factors by the subgroup populations to estimate subgroup emission, and sum across the subgroups to estimate total emission.

Earlier the Tier 1 method, which is a simplified approach based on default emission factors from the literature, has been used. However, according to IPCC (IPCC 2001) the Tier 2 approach should be used if livestock enteric fermentation represents a large proportion of the country's total emissions or important animal subgroups data is available for more correct estimation CH_4 emission. In Norway detailed information of the cattle production is available from the Cow recording System (TINE BA), which gives information of dairy cow production level and feeding. The system also gives information on beef production which includes age at slaughter, carcass weight, and average daily gain. This information will give additional country-specific information and can be used to develop sophisticated models that better incorporate information of diet composition, feed quality and animal production level and intensity.

The objective of this manuscript is to describe the methods used to estimate the CH_4 emissions from enteric fermentation in Norwegian's cattle and sheep production.

General emission factor development and animal subgroups

In all animal subgroups the following basic equation is used to calculate the CH_4 emission factor:

$$EF = (GE \cdot Ym \cdot 365 \text{ days/yr}) / 55.65 \text{ MJ/kg } CH_4$$

Where:
EF = emission factor, kg CH_4/head/yr
GE = gross energy intake, MJ/head/day
Y_m = CH_4 conversion rate, which is the fraction of gross energy in feed converted to CH_4.

This equation assumes an emission factor for an entire year (365 days). In some circumstances the animal category may be defined for a shorter period or a period longer than one year and in this case

the emission factor will be estimated for the specific period (e.g., lambs living for only 143 days and for beef cattle which are slaughtered after 540 days).

The new methods of calculation require subdividing the cattle and sheep populations by animal type, physiological status (dry, lactating or pregnant) live weight and age, and table AX-3 describe the animal categories used in the calculations.

In dairy cows additional information from the Cow Recording System concerning annual milk production and proportion of concentrate in the diet are used. The Cow Recording System also supply information about slaughter age, slaughter weight and average daily weight gain (ADG) for growing cattle, which are utilized in the calculations for growing cattle.

Table AX-3 Categories of cattle and sheep used in the Norwegian calculations of methane emission from enteric fermentation. Animal numbers from 2004[1]

Categories of cattle and sheep	Number of animal by year 2004
Dairy cows	315224
Beef cows	51802
Replacement heifers, < one year	156712
Replacement heifers, > one year	174568
Finisher heifers, < one year	3263
Finisher heifers, > one year	18410
Finisher bulls, < one year	13114
Finisher bulls, > one year	106308
Breeding sheep, > one year	878405
Breeding sheep, < one year	387860
Slaughter lamb, < one year. Jan- May	86554
Slaughter lamb, < one year. Jun- Sept	1010461

The number of animals in each category is based on the official register of production subsidies. The register covers 90-100 % of the animal populations. [1]

Calculation of methane emission from enteric fermentation in dairy cows and beef cows
To develop equations to calculate CH_4 emission from enteric fermentation in dairy cows the following set of equations were needed:

1. In the estimation of CH_4 emission we wanted to take into account the production level and diet composition. Therefore, we used 1.16 million observations from the Cow Recording System to develop standard lactation curves, which were used for calculation of standard feeding rations. The lactation curves were used to predict animal requirement for milk production through the whole lactation cycle. The lactation curve was estimated using a gamma distribution model as described by Wood *et al*. (1967). Length of the lactation period was standardised to 305 days, which gives a dry period of 60 days. The lactation curves were estimated in 500 kg intervals from 4500 to 9500 kg of milk (305 day lactation yields).
2. To calculate feed energy value (gross energy, metabolizable energy and net energy content), animal energy requirement and energy supplementation the Dutch net energy lactation system (NEL) was used (Van Es, 1975). This system has been used as the official energy system in Norway since 1992. Standard feed rations at different lactation yields (500 kg intervals) were calculated using three different forage qualities representing low, medium and high energy content (5.7, 6.1 and 6.6 MJ NEL per kg dry matter, respectively). These qualities represent a normal range in forage qualities found in the Norwegian cattle production. Four different concentrate mixtures were used in the diet formulation to complement the animal energy requirement at different

[1] The number of animals are updated annually. A new method for estimating heifers and bulls was implemented in 2013, see chapter 6.2.3 for further descreption.

production levels. The concentrate mixtures are representative of what is used in practical diet formulation in Norway.

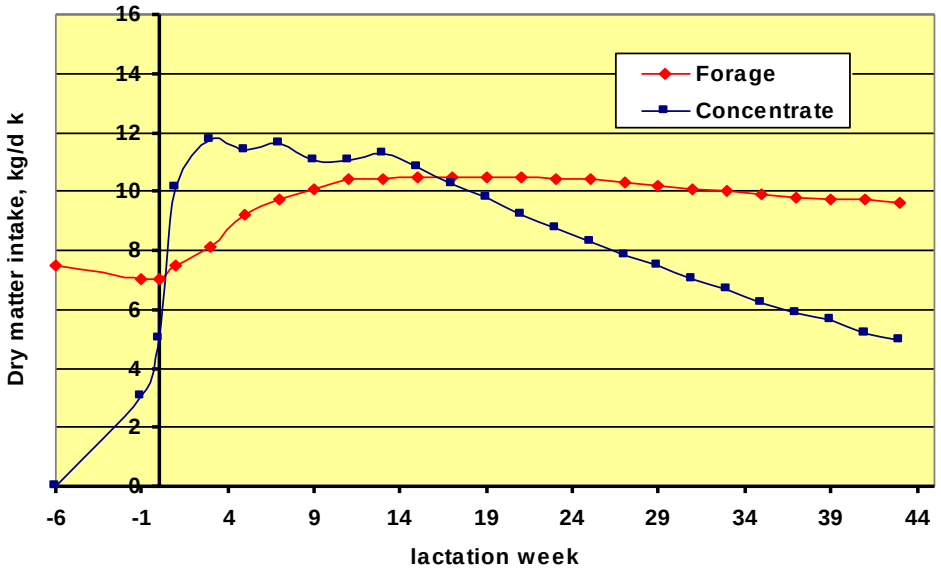
3. To estimate total feed intake and ration forage: concentrate ratio in the dry period and trough the lactation period a NDF (Neutral Detergent Fibre) intake system was used (Volden and Kjos, 2003). In the system, effect of daily milk yield and stage of lactation are taken into account when estimating the animal NDF intake capacity (g NDF per kg live weight). Daily feed intake is calculated from the following equation:

$$\text{Intake} = = \frac{\text{NDFIC}}{\text{(P)NDFF + (1-P)NDFC}} \qquad \frac{\text{ARNEL}}{\text{(P)NELF + (1-P)NELC}}$$

Where:
NDFIC = NDF intake capacity, g/kg body weight
ARNEL =Animal energy requirement, NEL per day
P = proportion of forage in the total ration
NDFF = forage NDF content, g/kg DM
NDFC = concentrate NDF content, g/kg DM
NELF = forage NEL content, per kg DM
NELC = concentrate NEL content, per kg DM

The point where the animal NDF intake capacity and the animal requirement intersect there is a unique solution, which represent the maximum intake and where the animal requirement is met. Consequently this equation can be used to maximize forage intake and at the same time fulfill the animal requirement at a chosen production level. In the equation the lactation curve information is used to define the animal requirement at different stages of lactation and different 305 d lactation yields. Figure H1 presents an example of estimated feed intake trough the lactation cycle for a lactation yield of 7000 kg. The estimates are based on the medium forage quality.

Figure AX-1. Example of estimated daily feed intake through the lactation cycle. Medium forage quality and a 305 d lactation yield of 7000 kg



4. In Norway grass silage is the dominating winter forage, approx. 40 % of the total fed ration calculated on energy basis, and the dairy cows are normally fed indoors for a period of six to eight months. Therefore, when estimating the CH_4 production from enteric fermentation we wanted to use equations are based on grass silage measurements, and that take into account the effect of diet composition on CH_4 production. This is in accordance with the recommendations of IPCC (IPCC 2001), which suggest to use a Tier 2 or a Tier 3 approach when estimation CH_4 emissions. After evaluating the literature we decided to use two equations published by Mills *et al*. (2003) and Kirchgessner *et al*. (1995). In the Mills *et al*. (2003) equation the effect of feed intake and dietary ADF and starch content are taken into account when predicting daily CH_4 production. The following non linear model is used:

$$\text{Methane (MJ/d)} = 45.98 - 45.98 \cdot e^{(-(-0.0011 \cdot \text{starch/ADF}+0.0045) \cdot \text{ME})}$$

Where:
Starch = diet starch content, g/kg dry matter'
ADF = diet ADF content, g/kg dry matter
ME = daily intake of metabolizable energy, MJ

The advantage of this equation is that it takes into account that both the feed intake level (expressed as metabolizable energy) and the ratio between rumen easily degradable carbohydrates and fibre which has shown to affect CH_4 production. Test of this equation has shown that it is robust and it covers both dry cows and cows at different production levels. The second equation we used was the one described by Kirchgessner *et al*. (1995). The advantage of this equation is that it covers a wide range of cattle production (growing cattle and lactating cattle) and that it includes information about diet composition. This equation also takes into account that CH_4 production is affected by dietary crude fat content:

$$\text{Methane (MJ/d)} = (63+79 \cdot \text{CF} + 10 \cdot \text{NFE} + 26 \cdot \text{CP} - 212 \cdot \text{CFat}) \cdot 55.65$$

Where:
CF = crude fibre, kg/d
NFE = nitrogen free extracts, kg/d
CP = crude protein, kg/d
CFat = Crude fat, kg/d

In development of the CH_4 emission equations we used average values of the two equations.

The information from the four points described above were used to calculate daily total feed intake, GE intake, ME intake and Y_m. Daily feed intake was calculated in 14 d intervals for the different 305 d milk yields and the three different forage qualities. From this data set we developed two multiple regression equations, which were used to calculate average daily GE intake, across stage of lactation, at different 305 d lactation yields and different concentrate proportion in the diet. The reason why we used this approach is that both these variables are available from the Cow Recording System. In the statistical analysis a Proc Mixed procedure was used with stage of lactation as a repeated measurement. GE was predicted from the following equation:

$$GE = 150.8 + 0.0205 \cdot Milk_{305} + 0.3651 \cdot Concentrate\_prop$$

Where:
GE = gross energy intake, MJ/day
$Milk_{305}$ = 305 d lactation yield,

Concentrate_proportion = proportion of concentrate in the total diet. Calculated on net energy basis.

The extent to which feed energy is converted to CH_4 depends on several feeding and animal factors. From the dataset described above it is directly or indirectly possible to take into account several of these factors. The following equation was developed to predict Y_m for dairy cows:

$$Y_m = 10.0 - 0.0002807 \cdot Milk_{305} - 0.02304 \cdot Concentrate\_prop$$

Where:

Y_m = methane conversion rate, %

Milk305 = 305 d lactation yield,

Concentrate_proportion = proportion of concentrate in the total diet. Calculated on net energy basis.

From this equation it can be seen that the proportion of GE converted to CH_4 decrease with increased milk yield and the proportion of concentrate in the diet. Table AX-4 present examples of GE and Y_m at different production levels and different proportions of concentrate in the diet.

Table AX-4. Daily intakes of gross energy (GE) and methane conversion rate (Ym) at different milk yields (305 d yield) and concentrate proportions in the diet

Milk yield, 305 d	Concentrate proportion, %	GE, MJ/d[1]	Y_m, %
5000	20	261	8.1
5000	50	272	7.4
7000	20	302	7.6
7000	50	313	6.9
9000	20	342	7.0
9000	50	354	6.3

[1]Feeding in the non lactating period included.

The Y_m values presented in table AX-4 are higher than the standard value suggested in IPCC Tier 2 (IPCC 2001), which is 6.5% for dairy cows. The discrepancies can probably be explained by differences in diet composition, which has a high proportion of forage in Norway, and the relative moderate milk yield compared to other western European countries and North America. Another reason can be differences in the scientific basis for prediction of CH_4 from enteric fermentation.

The same approach was used when predicting CH_4 production from beef cows. However, variable milk yield was not used. The lactation yield was fixed to 2500 kg and the concentrate proportion to 15%.

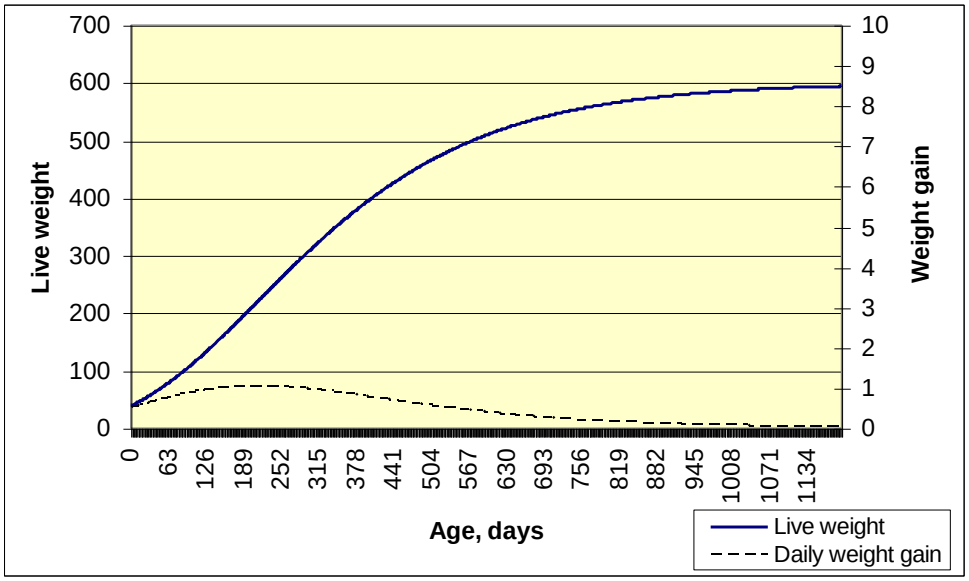
Calculation of methane emission from enteric fermentation in growing and finishing cattle

In the Norwegian Cow recording System growing and slaughter information is available for different categories of growing and finishing cattle. Approximately 90% of the growing cattle are attended to the recording system. Information about age at slaughter, carcass weight and ADG are available. When developing equations for predicting CH_4 emission in growing cattle we wanted to utilize this information. Therefore, the same approach as for dairy cows was used, including development of standard feed rations, which used the same forage qualities as for the dairy cows. Beef production in Norway comes mainly from one breed (Norwegian Red Cattle), which is described as an early-maturing breed. The feed rations used in practise contain an high proportion forage, with grass silage as the dominating forage, even during the finishing period. The carcasses required by the Norwegian market are normally heavy and average weight is approximately 300 kg.

To develop equations to calculate CH_4 emission from enteric fermentation in growing cattle the following set of basic equations were needed:

1. To describe changes in live weight and ADG over time a Gompertz growth equation based on Norwegian slaughter data was used (F. Walland, personal communication). From the Gompertz equation (figure AX-2) it is possible to estimate animal live weight (LW) and ADG. This information are further used to calculate animal energy requirement for maintenance and growth.

Figure AX-2. Gompertz growth function for prediction of live weight change and daily weight gain



Animal energy requirement was estimated based on an adjusted version of the Dutch Net energy lactation system (Van Es, 1975). The following equation was used to predict daily total energy requirement (NE MJ/d) for early-maturing bulls and heifers (Berg and Matre, 2001):

$$NE = 0.2926 \cdot LW^{0,75} + 0,020 \cdot LW + 17.3 \cdot ADG - 6.57$$

Where:

NE = net energy requirement for maintenance and growth
LW = live weight, kg
ADG = average daily weight gain, kg

2. To calculate feed energy value and energy supplementation the same system as for dairy cows, the Dutch net energy lactation system (NEL), was used (Van Es, 1975). Standard feed rations at different carcass weights and slaughter ages were calculated using the three different forage qualities. The French fill unit system (INRA, 1989) was used to estimate feed intake. Tests of this system have shown good agreements to what have been observed in Norwegian growing cattle experiments (J. Berg, personal communication). Animal feed intake capacity (IC) is dependent on LWt and age at maturing. In Norway, the forage is fed ad libitum, since a maximum forage intake is generally sought, and then the minimum allowance of concentrate necessary to meet energy requirement related to the production goal provided. Therefore, the same approach as for dairy cows was used to formulate feed rations:

$$\text{Intake} = = \frac{IC}{(P)FVF + (1\text{-}P)FVC} \qquad \frac{ARNEL}{(P)NELF + (1\text{-}P)NELC}$$

Where:

IC = animal intake, intake capacity, kg per day
ARNEL =Animal energy requirement, NEL per day
P = proportion of forage in the total ration
FVF = forage fill value, g/kg DM
FVC = concentrate fill vallue, g/kg DM
NELF = forage NEL content, per kg DM
NELC = concentrate NEL content, per kg DM

In this formula information from the growth curve (figure H1) is used to define the animal energy requirement at different age, LW and ADG. The growth curve is also used to predict IC from the relationship between age and LW. Standard rations were calculated for slaughter ages of 14, 18 and 22 months. Within slaughter age three different carcass weights were used; 290, 320 and 350 kg. This data matrix is a representative variation of what is observed in practise in Norway. Feed rations were calculated in 30 day intervals from day 150 to slaughter.

3. Since the most commonly used feeding strategy for growing cattle is to maximise the forage intake and that grass silage is the dominating forage in beef production the same equations as used for dairy cows was used to predict CH_4 production. These equations are expected to be robust because different production levels (Mills *et al*., 2003) and animal categories (Kirchgessner *et al*.,1995).

Based on the standard feed rations, daily intake of GE, ME and Ym were predicted. From the dataset a multiple regression analysis were accomplish to develop equations that predict GE and Ym from animal characteristics available from the Cow Recording System. The analysis showed that it was necessary to develop two set of equations, one for the period when animals are younger than one year and one from one year to slaughter. The following equations were developed to predict average daily intake of GE:

From day 150 to 365 days of age:

$$GE = 102.2 + 0.3849 \cdot CAW - 6.25 \cdot SLA$$

From 366 days to slaughter:

$$GE = 118.5 + 0.375 \cdot CAW - 4.05 \cdot SLA$$

Where:

GE = gross energy, MJ/d
CAW = carcass weight, kg
SLA = months at slaughter

Equations to estimate Ym:
From day 150 to 365 days of age:

$$Ym = 9.79 - 0.0187 \cdot CAW + 0.3155 \cdot SLA$$

From 366 days to slaughter:

$$Ym = 9.64 - 0.0045 \cdot CAW + 0.074 \cdot SLA$$

Where:

Y_m = methane conversion rate, %
CAW = slaughter weight, kg
SLA = months at slaughter

Table AX-5 present examples of daily GE intake and Y_m at different age at slaughter and carcass weights.

Table AX-5. Estimated average daily intake of gross energy (GE) and methane conversion rate Ym (%) at different slaughter age and carcass weights

Months at slaughter	Carcass weight	Period: 150 – 365 d		Period: 366 d - slaughter	
		GE, MJ/d	Y_m, %	GE, MJ/d	Y_m, %
14	290	126	8.8	191	9.4
14	350	149	7.7	193	9.1
22	290	76	11.3	138	10.0
22	350	99	10.2	161	9.7

The Y_m values presented in table AX-5 are higher than those presented as standard values in IPCC Tier 2 (IPCC 2001), which are 3% for feedlot cattle (90% or more concentrates in the diet) and 6,5% for other cattle. The discrepancies can probably be explained by differences in diet composition and the scientific basis for prediction of CH_4 from enteric fermentation.

Methane emissions from Norwegian's cattle population calculated from the developed equations are presented in table AX-6. To be able to compare our values to what has been suggested by IPCC, CH_4 emission per animal has been is standardised to kg/head/year. In prediction of total CH_4 emission from enteric fermentation data has been corrected for animal lifetime. Our emission factors (kg CH4/head/yr) for dairy cows and beef cows are comparable to what is presented by IPCC (IPCC 2001) for Western European cows. Our estimate is 10% higher, which are mainly due to differences in dry matter intake and the Y_m factor. The latter can be explained by a high proportion of forage in the diet and scientific basis for the equations used to predict CH_4 production. The same effect is found for growing cattle, which in IPCC (IPCC 2001) is suggested to be 57 kg CH_4/head/yr. Our average value, across all growing cattle categories, is 64 kg CH_4/head/yr, which is 11% higher than the IPCC value suggested for Western European countries (IPCC 2001).

Table AX-6. Methane emissions from enteric fermentation in Norwegian's cattle and sheep, as determined by emission factors taken from European literature (cattle) and IPCC Tier 2 guidelines for 2006 (sheep). Animal predictions from year 2004

Categories of cattle and sheep	GE intake, MJ/d	Methane lost, % of gross energy intake	Methane, kg per head per year[12]	Methane, t per year		
				1990	2000	2004
Dairy cows[1]	297	7.3	143	46194	40236	37605
Beef cows[2]	208	9.0	122	1971	6932	6312
Replacement heifers[3]	68	11.1	49	7999	8340	7611
Finisher heifers, < one year[4]	93	10.3	63	92	163	133
Finisher heifers, > one year[5]	74	11.1	67	742	982	997
Finisher bulls, < one year[6]	104	9.8	67	335	617	543
Finisher bulls, > one year[7]	114	10.1	76	10265	9716	9559
Breeding sheep, < one year[8]	51	4.5	15	3317	4212	2876
Breeding sheep, > one year[9]	40	6.5	17	13688	15127	14976
Slaughter lamb, < one year. Jan- May[10]	51	4.5	15	389	387	467
Slaughter lamb, < one year. Jun- Dec[11]	49	4.5	14	3142	3120	3768

[1]dairy cows: milk yield of 6469 kg per year
[2]Beef cows: milk yield of 2500 kg per year
[3]Replacement heifers: 27 months of at calving
[4]Finisher heifers < one year: 7.8 months at slaughter
[5]Finisher heifers > one year: 23.2 months at slaughter
[6]Finisher bulls, < one year: 19.8 months at slaughter
[8]Breeding sheep, < one year:
[9]Breeding sheep, > one year:
[10]Slaughter lamb, < one year. Jan- May: 4.8 moths at slaughter
[11]Slaughter lamb, < one year. Jun- Dec: 11 moths at slaughter
[12]Methane in kg per head per year was calculated as follows: ((GE intake, MJ/d x methane lost as % of GE/100)/55.65 MJ/kg)*365, where 55.65 is the energy content (MJ) of 1 kg of methane.

Calculation of methane emission from enteric fermentation in sheep

In Norway sheep are used for meat- and not for milk production. No information system as the Cow Recording System is available for sheep. Information is restricted to number of sheep younger and alder 1 year, the number of slaughtered sheep younger and alder 1 year, and how many sheep younger than 1year that are slaughtered each month throughout the year. Prediction of methane emission from sheep is therefore based on the Tier 2 method described by IPCC (IPCC 2001). In Norway most ewes lamb in the period march to may. There is a big demand for lamb meat around Christmas, and therefore, the major part of the lambs is slaughtered in the period October to December. Lambs that don't fulfil the minimum levels for weight will be fed and slaughtered the next year together with ewe lambs that are not pregnant. On this basis the sheep population has been divided in four categories: 1) lambs under 1 year of age slaughtered in the period from June 1st to December 31st, 2) lambs under 1 year of age slaughtered in the period from January 1st to may 31st, 3) breeding sheep under 1 year of age and 4) breeding sheep over 1 year. Slaughtered lambs younger than 1 one year are divided in two groups because lambs that live longer then December will have an increased energy requirement for maintenance, activity and growth. To be able to divide the number of slaughtered lambs younger than 1 year in the two groups, the portion of slaughtered lambs for each are calculated. This calculation are based on available information of the number of slaughtered lambs younger than 1 year, and the number of lambs slaughtered each month, for two subsequent years. The number of lambs slaughtered in the period from June 1st to December 31st, and in the period from January 1st to may 31st, are added up for each year and the portion according to total number for each period and year were calculated, and an average number of the same period from the two subsequent years where used. The average portion of lambs slaughtered in June – December were found to be 0.921 and the portion slaughtered in January – May were 0.0789.

Prediction of methane emission from sheep is based on the intake of GE and the fraction of GE converted to CH_4 (the CH_4 conversion rate, Y_m). The intake of GE is estimated from the net energy requirement and concersion factors from net energy to GE. According to IPCC (IPCC 2001) the Y_m for sheep over one year is 6.5 % and 4.5 % for sheep under one year.
The following equation was used to predict GE:

$$GE = [(NE_m + NE_a + NE_l + NE_p)/NEM_{ef}] + [(NE_g + NE_{wool})/NEG_{ef}]/ (DE/100),$$

Where:
GE = gross energy, MJ/day
NE_m = net energy for maintenance, MJ/day
$Ne_m = Cf_i \cdot (bodyweight)^{0,75}$
NE_a = net energy for activity, MJ/day
$Ne_a = C_a \cdot bodyweight$
NE_l = net energy for unknown lactation, MJ/day
$NE_l = ((5 \cdot Wg_{wean}) / 365\ days) \cdot EV_{milk}$
NE_p = net energy for pregnancy, MJ/day
$NE_p = C_{pregnancy} \cdot NE_m$
NE_g = net energy for growth, MJ/day
NE_g = / (365 days/year)
NE_{wool} = net energy for one year of wool production, MJ/day
$NE_{wool} = (EV_{wool} \cdot$ yearly wool production, kg/year)/ (365 days/year)

NEM_{ef} = the ratio of net energy available in a diet for maintenance to digestible energy consumed
NEG_{ef} = the ratio of net energy available for growth in a diet to digestible energy consumed
DE = digestible energy in present of gross energy

Net energy for maintenance is calculated as metabolic bodyweight (bodyweight^{0,75}) multiplied with a coefficient (Cf_i) varying with age and sex. Cf_i provided by IPCC (IPCC 2001) is 0.217 for ewes over one year and 0.2496 for intact males over one year. For sheep under one year it is 0.236 for ewes and 0.2714 for intact male lambs. It is not possible to divide the number of sheep by sex, and therefore an average value of 0.2333 for sheep over one year and 0.2537 for sheep under one year has been used. Net energy for activity is calculated as bodyweight multiplied by a coefficient (C_a) corresponding to the animal's feeding situation. According to IPCC (IPCC 2001) C_a for housed ewes is 0.009, sheep grazing on flat pasture 0.0107, sheep grazing on hilly pasture 0.024, and for lambs kept indoor 0.0067. The feeding situation varies during the year, and therefore an average of the first three values (0.0146) has been used for sheep over one year, and an average of the three last values (0.0138) has been used for sheep under one year. Calculation of net energy for lactation is based on the formula for unknown lactation, because sheep in Norway are used for meat production. This formula includes average daily gain for each lamb in the period from birth to weaning, (WG_{wean}), in kg. Weaning was set at seven weeks of age, which is taken as the time when the lambs are dependent on milk for half their energy requirement, and WG_{wean} was set to 21.5 kg. The energy required for producing 1 kg of milk (EV_{milk}) is 4.6 MJ /kg. Net energy for lactation is calculated for breeding sheep over one year, and for two lambs for each ewe. Net energy for pregnancy is calculated from a coefficient for pregnancy, ($C_{pregnancy}$), multiplied with net energy for maintenance. According to IPCC (IPCC 2001) $C_{pregnancy}$ is 0.077 for one lamb, 0.126 for two lambs and 0.15 for more than two lambs. When the GE intake is calculated an average of the first two values (0.1015) is used for breeding sheep under one year, and an average of all three values (0.1177) is used for breeding sheep over one year. The formula used for calculating net energy for growth include bodyweight at the time of weaning (BW_i), bodyweight at one year of age or at the time of slaughtering (BW_f), average daily gain in the period from weaning to on year of age or slaughtering (WG_{lamb}), and the given factors a and b. This formula was tried out, but the outcome was not in accordance with expected theoretical numbers, and therefore, another method was used to estimate the net energy requirement for growth. This method is based on average daily gain from birth to slaughtering and a net energy requirement of 17.3 MJ per kg gain was used. Average daily gain was calculated on the assumptions that weight at birth was 4.5 kg (Nedkvitne, 1989). Net energy for growth is calculated for both slaughtered and breeding sheep younger than 1 year. The need for net energy for wool production is calculated as the amount of wool produced during a year multiplied with the net energy content of 1 kg wool (EV_{wool}), which is 24 MJ/kg (IPCC 2001). The quantity of wool produced was set to 1.9 kg for sheep under one year and 4.1 kg for sheep over one year.

From the estimated net energy requirement, daily GE intake is calculated based on conversion factors from net energy to GE. Conversion ratios was derived from the Dutch net energy system (Van Es, 1975), where values of 65, 81 and 43 % were used as average conversion rates from net energy to metabolizable energy, from metabolizable energy to digestible energy and from digestible energy to GE, respectively.

For slaughtered lamb under one year, the requirements for net energy (MJ/day), NE_m, NE_a, NE_g, and NE_{wool}, where added up and converted into GE as described above. For these two animal sub-categories, June – December and January – May, the CH_4 emission was calculated for the living period, since the lamb live shorter than one year. When calculating methane emission from lambs it is, according to IPCC (2001), assumed that lambs do not emit methane until half of their energy requirement is covered from milk, and this phase has been set to 7 weeks of age. Therefore, when calculating methane emission from lambs younger than one year, daily emission is multiplied with the age at slaughter subtracted the 7 weeks. For breeding sheep under one year the requirements for net energy (MJ/day), NE_m, NE_a, NE_g, and NE_{wool}, where multiplied by 365 days, and net energy for pregnancy in MJ/day where multiplied by 150 days. Then the total requirement for net energy,

MJ/year, was divided by 365 to get the energy requirement in MJ/day, and then converted GE. For breeding sheep over one year calculation of total net energy requirement was done in the same way as for breeding sheep under one year. For this category of sheep net energy for unknown lactation (IPCC 2001) was used and this was done by multiplying daily requirement by 96 days, and then divided by 365 days.

In table AX-6 daily GE intake and CH_4 production for the different sub-categories of sheep is presented. The CH_4 emission values, expressed as kg CH_4/head /year, are higher than IPCC Tier 1 values. It is likely that the IPCC Tier 1 CH_4 emission factors for sheep under Norwegian feeding practices and management strategies are set too low.

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Annex XI: Quantification of differences between Reference and Sectoral Approach

In the review of the Norwegian greenhouse gas inventory submitted in 2011 the ERT raised potential problems with non-inventory elements of Norway's annual submission under the Kyoto Protocol. Norway was asked to explain the difference between Reference Approach (RA) and Sectoral Approach (SA). Norway has examined the differences and the results are explained in this annex. Remaining issues are to examine and reduce statistical differences. See Annex XII.

Reference versus sectoral approach
Norway has calculated energy consumption and CO_2 emissions from energy combustion based on RA and SA. The supply side in the RA is from the national energy balance that is included in Annex III in the NIR. In previous submissions we have used energy balance data reported to IEA in RA even if the energy balance reported in Annex III also in previous submissions have been the national energy balance. The supply data in RA are now consistent with the energy balance data used in the SA.

The result of the estimation with the two methods is shown in Table 1. There are large differences between the output from RA and SA, both for the energy consumption data and the CO_2 emissions. The difference between the *fuel consumption* in the RA and SA ranges from about –14 per cent to + 45 per cent. The deviations for CO_2 emissions are generally around 5 percentage points higher. The highest discrepancy for CO_2 is in 1999-2001 and in 2004-2006. For 2011, the difference for CO_2 is 9 per cent. The large discrepancies are primarily due to statistical differences in the energy balance, as shown below.

Table 1. Comparison of fuel consumption and CO_2 emission data between the Reference Approach (RA) and the Sectoral Approach (SA). 1990-2011.

	Fuel Consumption			**CO_2 emissions**		
Year	RA, apparent consumption (PJ)	SA (PJ)	Difference RA-SA (%)	RA (Gg)	SA (Gg)	Difference (%)
1990	335	384	-12.8	24 090	25 870	-6.9
1991	400	381	5	28 455	25479	11.7
1992	379	388	-2.3	26 646	25 965	2.6
1993	378	403	-6.4	26 496	26 952	-1.7
1994	404	424	-4.8	28 646	28 348	1.1
1995	431	422	2.1	30 307	28 267	7.2
1996	397	460	-13.6	28 066	31 085	-9.7
1997	450	464	-3.1	31 704	31 171	1.7
1998	508	464	9.5	35 526	31 183	13.9
1999	566	463	22.1	39 883	31 449	26.8
2000	654	453	44.3	45 941	30 487	50.7
2001	611	478	27.7	41 695	32 565	28
2002	509	484	5.1	35 409	32 753	8.1
2003	546	504	8.2	37 797	34 110	10.8
2004	647	509	27.2	45 833	34 147	34.2
2005	598	498	20.2	42 584	33 704	26.3
2006	637	519	22.7	45 766	34 616	32.2
2007	501	529	-5.3	34 505	35 166	-1.9
2008	580	526	10.4	40 389	34 543	16.9
2009	555	538	3.2	38 871	35 080	10.8
2010	653	554	17.8	44 532	36 598	21.7
2011	561	540	3.9	39 095	35 774	9.3

Source: Statistics Norway/Climate and Pollution Agency

Quantification of differences between RA and SA

Summary. *We have made a comparison of the fuel consumption in RA and SA to the energy balance where we explain the differences between RA and SA. The comparison was made for natural gas and solid and liquid fuels separately. This is an answer to questions raised in the Saturday Paper by the ERT reviewing the Norwegian 2011 submission. The comparison is summarized in Table 3 in this annex.*

The main result is that the difference between the energy consumption in RA and SA is mainly due to statistical differences in the energy balance (column V in Table 3). In addition, a number of other smaller differences were identified. The remaining difference between RA and SA after adjusting for these items is within +/- 3 per cent

There are very large statistical differences in the Norwegian energy balance, and they fluctuate strongly between years. An analysis of the statistical differences is included in a separate appendix (XXX).

The Reference Approach is a method to use the supply part of the energy balance to calculate CO_2 emissions from fuels. A simple correction is used to exclude non-combustion emissions. The result is then compared with the sectoral approach to combustion emissions (source category 1A). For Norway, the RA gives for many years large deviations from the SA with respect to both energy use and CO_2 emissions.

The SA is based on the consumption part of the energy balance. This section shows how the RA and the SA corresponds to the energy balance. *The main conclusion is that the major cause of deviations between the approaches is the statistical differences in the energy balance.*

The supply data used in in the RA Table 1A(b) are from the national energy balance reported in the NIR. See the first paragraph under *Reference versus sectoral approach* in this annex. The only differences are in the NCV values for natural gas and crude oil production, and the inclusion of lubricants and bitumen in the RA. When corrected for these items, the total supply in the RA is equal to the net domestic supply (item 7) in the energy balance for these fuels.

Item 7 Net domestic supply in the energy balance is equal to the sum of the following items in the balance (according to the definition of the statistical difference (item 11)):

Table 2: Energy Balance and its allocation in the Reference Approach and the GHG inventory

8. Energy converted	8.1-8.2 (blast furnaces and petroleum refineries): Transformation to other fossil fuels. Not included in the inventory. Part of statistical differences in transformation 8-3-8.6 (power and heating plants): Sectoral Approach – 1A1a
1.2. Production of derived energy bearers	Not included in the inventory. Part of statistical differences in transformation
9. Consumption by energy sector	Sectoral Approach – 1A1a-c *Exceptions:* 9.1.2. Flaring on oil fields Inventory: 1B2c RA: Excluded 9.3. Petroleum refineries: In the inventory, burning off of coke is in 1B2a-4
10. Losses in transport and distribution	Only flares in manufacturing In the inventory, included in 2 Industrial processes
11. Statistical differences (7-(8-1.2)-9-10-12-13)	Not included in the inventory: Statistical differences
12. Consumption for non-energy purposes	- In the inventory: allocated to 2 Industrial processes - In the RA: included in the correction item for feedstock and non-energy use
13. Net domestic consumption	SA: 1A2-1A5. *Exceptions:* Coal and coke used as reducing agents with utilization of heat is accounted here in the energy balance, and not in item 12. - In the inventory, this use is allocated to 2 - Industrial processes - In the RA, this use is included in the correction item for feedstock and non-energy use

Note: Item 13.1 in the energy balance is the sum of items 12 and 13, *i.e*, net domestic consumption including non-energy use.

Table 2 shows that the net supply includes items that are handled in different ways in the inventory:

- Combustion which is included in the sectoral approach
- Emissions that are included elsewhere in the inventory
- Items that are not included in the inventory but appear as statistical differences.

In the RA, the energy consumption and CO_2 emissions are corrected for ”non-energy use and feedstocks”. As currently implemented, this correction includes item 12 Consumption for non-energy purposes and the part of item 13 Net domestic consumption which is reducing agents. The correction also includes lubricants and bitumen, which are not part of the national energy balance net supply.

This means that the following items will remain as differences between the Reference and Sectoral approaches:

- Statistical differences. This includes
    - Main statistical difference (item 11). Range: -20 PJ to190 PJ (excluding waterfall energy, electricity, and district heating).
    - Statistical differences within the transformation sector. This appears when the production of derived energy bearers (item 1.2) is different from the consumption in the transformation sectors (item 8). Transformation to heat or power by consumption is handled in the sectoral approach and is excluded from this comparison. Range: 0 PJ to 30 PJ.

  Possible causes of the statistical differences are discussed in Section *Discussion of statistical differences*.
- Emissions that are included elsewhere in the inventory, but were omitted from the correction item in the RA:
    - Losses (item 10, i.e, flaring in manufacturing). Range: 2-4 PJ.
    - Burning off of coke in refinery crackers and related emissions. Range: 6-10 PJ.

Some differences between the Reference and Sectoral approaches still remain when correcting for these items. The remaining differences may be due to minor differences in definitions and scope, and to errors in the energy or emission inventories. More details are given in Section *Discussion of statistical differences*. Range: -10 PJ to 10 PJ.

The analysis is summarized in Table 3 below. The analysis in the CRF tables is shown in the left part. Further corrections are included in the following columns.

Table 3. Overview over the Reference and Sectoral approaches for energy. PJ.

	Consumption data from CRF Table1.A(c)					Additional adjustments in RA consumption			Remaining difference RA-SA	
Unit: PJ	RA: Apparent consumption (*incl* non-energy use and feedstocks)	SA: Consumption (*incl* Other fuels)	Correction for non-fuel use and feedstocks in CRF	Difference RA-SA, PJ	Difference RA-SA, per cent of SA	Statistical differences	Other corrections	*Other fuels* in SA excluded from comparison	Remaining difference RA-SA, PJ	Remaining difference RA-SA, per cent of SA
	A	B	=D+Q+S			N	=E+P+R		U*	V*
1990	431	384	96	-49	-13 %	-42	8	-4	-11	-2.8 %
1991	486	381	86	19	5 %	22	7	-4	-6	-1.7 %
1992	465	388	86	-9	-2 %	-9	10	-4	-5	-1.4 %
1993	470	403	93	-26	-6 %	-28	10	-5	-3	-0.7 %
1994	500	424	96	-20	-5 %	-20	7	-5	-3	-0.6 %
1995	534	422	103	9	2 %	14	5	-5	-5	-1.3 %
1996	500	460	103	-63	-14 %	-59	5	-5	-4	-1.0 %
1997	564	464	114	-15	-3 %	-11	4	-5	-3	-0.6 %
1998	629	464	121	44	9 %	43	5	-5	1	0.2 %
1999	683	463	118	102	22 %	103	4	-6	1	0.1 %
2000	773	453	119	201	44 %	200	7	-6	-0	-0.1 %
2001	743	478	132	132	28 %	128	4	-7	8	1.6 %
2002	631	484	122	25	5 %	29	2	-7	1	0.1 %
2003	676	504	130	42	8 %	47	-1	-8	4	0.9 %
2004	776	509	129	139	27 %	150	0	-8	-3	-0.6 %
2005	721	498	123	100	20 %	109	1	-9	-1	-0.1 %
2006	756	519	119	118	23 %	126	-0	-9	1	0.2 %
2007	625	529	125	-28	-5 %	-27	6	-9	2	0.3 %
2008	711	526	130	55	10 %	62	3	-10	-1	-0.2 %
2009	666	538	111	17	3 %	25	4	-9	-3	-0.5 %
2010	768	554	115	99	18 %	95	6	-11	8	1.5 %
2011	681	540	120	21	4 %	31	5	-13	-2	-0.4 %

Source: Statistics Norway/Climate and Pollution Agency

Notes

a) Difference between ”Reference approach” and ”Apparent energy consumption” in CRF table 1.A(c), equal to the total from non-fuel use in table 1.A(d) (=D+Q+S in table 4)

b) Energy balance items ”Statistical differences” *plus* balance of non-combustion transformation items (consumption in blast furnaces, petroleum refineries and other conversion *minus* production of derived energy bearers). (=N in table 4)

c) Energy balance item ”Losses”; petrol coke/CO gas burnt in refineriea and reported as fugitive emissions in the inventory; correction for different NCV values used for condensate in energy balance and in the RA. (=E+P+R in table 4)

d) *Other fuels* are currently not included in the reference approach

The following Tables 4-8 show in more detail how the energy balances and the Reference and Sectoral approaches are related for the different fuel groups. Table 4 is a combined table for liquid and solid fuels, in PJ. For natural gas there are Tables 4-7 in Sm^3, PJ, and CO_2.

The reasons for these choices are purely practical: Gaseous fuels comprise only a single fuel and thus simple to handle, and variations in NCV and C content means that data in Sm^3, PJ and CO_2 give different and relevant information. For liquid and solid fuels, transformation means that only tables covering all fuels are meaningful. The PJ table is the simplest one to prepare. Liquid and solid were combined because one of the energy types in the energy balance (”other gases”) is a combination of mainly secondary fuels derived from both liquid and solid primary fuels.

Solid fuels and liquids

Table 4 is organized in four parts, from left to right. After each part, the remaining difference between RA and SA is given.

1. The consumption according to RA (uncorrected) and SA
2. Differences between the RA and the energy balance: lubricants and bitumen, and differences in NCV values. When adjusted for these items, the RA supply is equal to the energy balance.
3. Statistical differences
4. Emissions that is included elsewhere in the inventory.

Table 4. Overview of discrepancies in energy goods. Solid and liquid fuels. PJ

Unit: PJ	Consumption data from CRF Table1.A(c)			Included in RA, but not in the NIR energy balance			Remaining difference RA-SA	Included in RA and energy balance, but not included in total emissions (in any source categories): Statistical differences and other discrepancies between supply and consumption in the energy balance							Remaining difference RA-SA
	RA: Apparent consumption (*incl* non-energy use and feedstocks)	SA: Consumption	Difference RA-SA	Fuel types not included in NIR energy balance (lubricants, bitumen)	Different NCV values for condensate production	Total adjustment		8.1. Transformation - In blast furnaces	8.2. Transformation - In crude petroleum refineries	8.7. Other conversion	1.2. Production of derived energy bearers	SDT. Statistical differences within transformation (8.1+8.2+8.7-1.2)	11. Statistical differences (7-8+1.2-9-10-13.1)	Total adjustment (SDT + 11)	
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
			=A-B			=D+E	=C-F					=H+I+J+K		=L+M	=G-N
1990	363	288	75	11	-0	**10**	65	1	575	-	591	-15	-6	**-21**	86
1991	397	279	118	13	-0	**13**	105	2	545	-	573	-26	56	**30**	75
1992	357	279	78	12	-0	**11**	67	1	615	-	635	-19	7	**-12**	79
1993	357	289	68	13	-1	**12**	55	1	613	-	640	-26	-6	**-32**	87
1994	397	302	95	15	-3	**12**	83	2	633	-	664	-29	23	**-6**	89
1995	407	298	109	14	-4	**10**	99	2	583	-	603	-18	26	**8**	91
1996	392	327	65	17	-5	**12**	53	1	648	-	678	-28	-13	**-41**	93
1997	404	321	83	16	-7	**9**	74	2	655	-	679	-22	-0	**-22**	96
1998	441	325	115	16	-6	**10**	106	2	641	-	651	-8	17	**10**	96
1999	505	332	173	15	-7	**8**	165	2	658	-	682	-22	95	**73**	92
2000	582	302	280	13	-6	**7**	273	2	656	10	669	-1	178	**177**	96
2001	458	312	146	12	-8	**5**	141	1	616	11	627	1	34	**35**	106
2002	433	311	121	13	-10	**3**	118	1	579	11	601	-9	24	**14**	104
2003	435	320	114	13	-13	**-1**	115	1	645	12	670	-12	22	**10**	105
2004	589	316	273	14	-12	**2**	272	2	619	11	648	-17	189	**172**	99
2005	538	307	231	15	-12	**3**	228	1	681	11	713	-20	151	**131**	98
2006	555	322	234	15	-13	**2**	232	2	718	13	754	-21	158	**138**	94
2007	396	323	74	17	-7	**11**	63	2	713	11	747	-20	-17	**-37**	100
2008	480	311	169	16	-8	**8**	161	2	660	11	693	-19	82	**63**	99
2009	446	310	136	18	-9	**9**	126	2	665	10	699	-22	64	**42**	85
2010	461	323	138	15	-8	**7**	130	3	631	11	666	-21	57	**36**	94
2011	450	319	132	17	-9	**8**	123	3	703	11	735	-19	52	**33**	90

Source: Statistics Norway/Climate and Pollution Agency

*Table 4 **continue**. Overview of discrepancies in energy goods. Solid and liquid fuels. PJ*

Unit: PJ	Included in RA and energy balance, but reported in other source categories [than 1A=Sectoral Approach]					Remaining difference RA-SA	
	10. Losses in transport and distribution	12. Consumption for non-energy purposes	*part of* 9.3. Consumption in energy sectors (petrol coke/CO in refinery)	*part of* 13 Net domestic consumption (coal and coke as reducing agent)	Total adjustment: 10+12+(9.3pp+13pp)	PJ	% of SA
	P	Q	R	S	T	U	V
					=P+Q+R+S	=O-T =C-(F+N+T)	
1990	2	47	6	39	**94**	-9	-3.0 %
1991	2	41	6	32	**81**	-6	-2.0 %
1992	3	42	8	32	**84**	-6	-2.0 %
1993	3	50	8	29	**90**	-3	-1.0 %
1994	3	52	7	29	**91**	-2	-0.6 %
1995	3	53	6	36	**97**	-6	-2.0 %
1996	3	53	7	33	**96**	-3	-0.9 %
1997	3	56	8	33	**100**	-4	-1.3 %
1998	3	52	8	36	**100**	-4	-1.2 %
1999	4	49	7	35	**95**	-3	-0.9 %
2000	3	49	10	37	**100**	-4	-1.4 %
2001	4	65	8	32	**108**	-3	-0.8 %
2002	3	67	9	25	**104**	-0	0.0 %
2003	2	68	10	25	**105**	-0	-0.1 %
2004	3	57	9	31	**100**	-1	-0.3 %
2005	2	59	11	24	**96**	1	0.4 %
2006	2	59	11	21	**92**	2	0.5 %
2007	3	65	10	23	**100**	0	0.0 %
2008	3	64	8	25	**99**	-1	-0.2 %
2009	3	57	10	15	**85**	-0	0.0 %
2010	4	58	10	21	**93**	1	0.4 %
2011	3	57	10	22	**93**	-3	-0.9 %

Source: Statistics Norway/Climate and Pollution Agency

Note to Table 4: The correction for ”non-energy use and feedstock” in the CRF includes items D, Q, and S in the table.

Natural gas

Tables 5-7 that follows are simpler than Table 4, but all relevant columns are included.

The difference between RA and SA with respect to energy consumption is presented in volume terms in Table 5. The primary data are usually by volume, and this approach avoids problems with finding the correct NCV values.

The following columns in Table 5 show that the remaining difference between RA and SA is almost wholly explained by non-energy use, losses, and statistical differences. When adjusted for these terms, the remaining difference is well below 1 per cent.

In Table 6, the same analysis is presented in energy units (PJ). Variations in NCV between years and between sectors blur the clearer picture from the Sm^3 data in Table 5.

Calculation notes to Table 6:
In this table, the data for RA and SA were converted using the NCVs from CRF Table 1 A(b). These values correspond to a large fraction of high-NCV gas used in offshore oil and gas extraction. The correction items from the energy balance were converted using the NCVs in the national energy balance. These values reflect the composition of produced gas, and are closer to dry gas values. The choice of NCV for the energy balance items is somewhat arbitrary, since it is not known in which part of the inventory the statistical differences originate, and the composition of feedstock gas is not known.

Table 5. Overview of discrepancies on energy goods. Natural gas. Million Sm^3

	Consumption data			Included in RA, but not in SA. Data from NIR energy balances, underlying data in Sm3				Remaining difference RA-SA	
Unit: 10^6 m^3	RA: Apparent consumption	SA: Consumption (recalculated with NCV of RA/SA)	Difference RA-SA	10. Losses in transport and distribution	11. Statistical differences (7-8+1.2-9-10-13.1)	12. Consumption for non-energy purposes	Total: 10+11 +12	10^6 m^3	% of SA
1990	1 698	2 293	-595	-	-595	-	-595	-0	0.0 %
1991	2 204	2 416	-212	-	-212	-	-212	0	0.0 %
1992	2 676	2 590	85	-	85	-	85	-	0.0 %
1993	2 826	2 724	102	-	102	-	102	0	0.0 %
1994	2 549	2 924	-376	-	-376	-	-376	1	0.0 %
1995	3 142	2 967	174	-	174	-	174	0	0.0 %
1996	2 694	3 183	-489	-	-490	-	-490	0	0.0 %
1997	3 987	3 449	538	7	307	223	537	1	0.0 %
1998	4 693	3 319	1 374	22	926	419	1 367	8	0.2 %
1999	4 451	3 132	1 319	19	843	462	1 324	-5	-0.2 %
2000	4 772	3 619	1 153	37	636	480	1 153	1	0.0 %
2001	7 130	3 987	3 143	14	2 552	576	3 142	1	0.0 %
2002	4 958	4 144	814	11	409	429	849	-35	-0.9 %
2003	6 016	4 391	1 625	13	1 012	597	1 623	3	0.1 %
2004	4 687	4 614	72	14	-630	687	70	2	0.1 %
2005	4 566	4 548	18	10	-598	605	17	2	0.0 %
2006	5 024	4 714	311	11	-325	621	308	3	0.1 %
2007	5 749	4 937	812	26	296	511	834	-22	-0.4 %
2008	5 770	5 139	632	13	-15	650	648	-16	-0.3 %
2009	5 579	5 546	34	20	-467	520	73	-40	-0.7 %
2010	7 803	5 586	2 217	15	1 648	544	2 207	10	0.2 %
2011	5 856	5 296	560	15	-49	591	557	4	0.1 %

Source: Statistics Norway/Climate and Pollution Agency

Table 6. Overview of discrepancies on energy goods. Natural gas. PJ

Unit: PJ	Consumption data from CRF Table1.A(c)			Included in RA, but not in SA. Data from NIR energy balances				Remaining difference RA-SA	
	RA: Apparent consumption (*incl.* non-energy use and feedstock)	SA: Consumption	Difference RA-SA	10. Losses in transport and distribution	11. Statistical differences (7-8+1.2-9-10-13.1)	12. Consumption for non-energy purposes	Total: 10+11 +12	PJ	% of SA
	A	B	C	P	M	Q	T	U	V
			=A-B				=P+M+Q	=C-T	
1990	68	92	-24	-	-22	-	-22	-2	-2.5 %
1991	89	97	-9	-	-8	-	-8	-1	-0.7 %
1992	108	104	3	-	3	-	3	0	0.3 %
1993	114	110	4	-	4	-	4	0	0.3 %
1994	103	118	-15	-	-14	-	-14	-1	-0.9 %
1995	127	119	7	-	7	-	7	0	0.4 %
1996	108	128	-20	-	-18	-	-18	-1	-1.1 %
1997	160	138	22	0	11	8	20	2	1.3 %
1998	188	133	55	1	34	15	50	5	3.9 %
1999	178	125	53	1	31	17	48	5	3.8 %
2000	191	145	46	1	23	17	42	4	2.9 %
2001	286	160	126	1	92	21	114	12	7.6 %
2002	199	166	33	0	15	15	31	2	1.2 %
2003	241	176	65	0	37	22	59	7	3.7 %
2004	188	185	3	0	-23	25	3	0	0.2 %
2005	183	182	1	0	-22	22	1	0	0.1 %
2006	201	189	12	0	-12	22	11	1	0.7 %
2007	229	197	32	1	11	18	30	3	1.3 %
2008	230	205	25	0	-1	23	23	2	1.0 %
2009	220	219	1	1	-17	19	3	-1	-0.6 %
2010	307	220	87	1	59	19	79	8	3.8 %
2011	231	209	22	1	-2	21	20	2	1.1 %

Source: Statistics Norway/Climate and Pollution Agency

Table 7 below presents the differences between RA and SA with respect to CO_2 emissions. Most of the difference is likely due to problems with assigning correct NCV values to both reference and sectoral approaches. The problems with NCV values in Table 8 feed directly into the CO_2 comparison. In addition, the Norwegian NCV and C content values now used might not fully reflect the actual content of gas burned offshore. For most years after 2000 the data indicate that the gas has a even higher energy and carbon content than the factors used. See Table 8. The inventory generally uses plant-specific data for consumption by volume and for CO_2 emissions, but plant specific NCV data have not been obtained so far.

Calculation notes to Table 7:
CO_2 emissions corresponding to the correction items are calculated using NCV and C content values of the energy balance.

Table 7. Overview of discrepancies on energy goods. Natural gas. Gg CO_2

	Emission data from CRF Table1.A(c)			Included in RA, but not in SA				Remaining difference RA-SA	
Unit: Gg CO_2	RA: Actual CO_2 emissions	SA: CO_2 emissions	Difference RA - SA	10. Losses in transport and distribution	11. Statistical differences (7-8+1.2-9-10-13.1)	12. Consumption for non-energy purposes ---------- *RA emissions are already corrected*	Total: 10+11	Gg CO_2	% of SA
1990	3 975	5 185	-1 210	-	-1 227	-	-1 227	17	0.3 %
1991	5 158	5 486	-328	-	-445	-	-445	118	2.1 %
1992	6 263	5 903	360	-	178	-	178	182	3.1 %
1993	6 615	6 198	417	-	213	-	213	204	3.3 %
1994	5 965	6 726	-761	-	-805	-	-805	44	0.7 %
1995	7 346	6 797	549	-	374	-	374	175	2.6 %
1996	6 296	7 306	-1 009	-	-1 041	-	-1 041	32	0.4 %
1997	8 760	7 964	796	15	639	-	654	141	1.8 %
1998	9 934	7 656	2 278	46	1 909	-	1 955	323	4.2 %
1999	9 248	7 631	1 617	38	1 728	-	1 766	-150	-2.0 %
2000	9 962	8 765	1 197	76	1 307	-	1 383	-186	-2.1 %
2001	15 223	10 016	5 207	29	5 212	-	5 241	-34	-0.3 %
2002	10 526	10 327	199	23	831	-	853	-655	-6.3 %
2003	12 591	10 919	1 672	27	2 063	-	2 090	-418	-3.8 %
2004	9 285	11 301	-2 015	28	-1 284	-	-1 257	-759	-6.7 %
2005	9 190	11 356	-2 166	19	-1 213	-	-1 194	-972	-8.6 %
2006	10 210	11 263	-1 053	23	-656	-	-633	-420	-3.7 %
2007	12 087	11 635	452	53	595	-	648	-196	-1.7 %
2008	11 827	11 787	41	26	-30	-	-5	45	0.4 %
2009	11 546	12 487	-941	39	-938	-	-898	-43	-0.3 %
2010	16 494	12 778	3 716	31	3 313	-	3 344	372	2.9 %
2011	11 987	12 189	-202	30	-98	-	-69	-133	-1.1 %

Source: Statistics Norway/Climate and Pollution Agency

Table 8 gives the NCV and carbon content values used in the RA and SA in the 2013 submission. NCV values used in the national energy balance are also shown. The carbon content to be used with correction items from the energy balance was calculated for these tables and has not been published elsewhere (method shown below). Finally, an "actual" C content is calculated as the ratio between the implicit kg C/Sm^3 factor in the inventory and the NCV used. The high values after 2000 indicate that the NCV now used may be too low for these years.

Calculation notes to Table 8:
The carbon content to be used with a given NCV is calculated by inverting the formula in OLF (2008) for estimating CO_2 factors (in kg/Sm^3) from the NCV (in MJ/Sm^3): $fCO_2 = 0.0724 * NCV - 0.5771$.

Table 8. NCV and C content data for natural gas

	NCV used in energy balance	NCV used in RA and SA	C content to be used with Energy balance correction items	C content used in RA and SA	"Actual C content" (SA)
	MJ/S m^3	MJ/Sm^3	tC/TJ	tC/TJ	tC/TJ
1990	36.45	40.30	15.43	15.84	15.30
1991	36.99	40.30	15.49	15.84	15.37
1992	36.74	40.30	15.46	15.84	15.42
1993	36.81	40.30	15.47	15.84	15.40
1994	37.53	40.29	15.55	15.84	15.57
1995	37.62	40.27	15.56	15.84	15.51
1996	37.35	40.26	15.53	15.84	15.55
1997	36.72	40.11	15.46	15.82	15.70
1998	36.45	40.07	15.43	15.82	15.70
1999	36.27	39.99	15.41	15.81	16.62
2000	36.36	40.03	15.42	15.81	16.50
2001	36.18	40.05	15.40	15.82	17.11
2002	36.00	40.07	15.37	15.82	16.96
2003	36.12	40.06	15.39	15.82	16.93
2004	36.12	40.04	15.39	15.81	16.68
2005	36.01	40.01	15.38	15.81	17.02
2006	35.88	40.00	15.36	15.81	16.29
2007	35.70	39.84	15.34	15.80	16.13
2008	35.75	39.88	15.34	15.80	15.69
2009	35.72	39.49	15.34	15.76	15.55
2010	35.74	39.36	15.34	15.75	15.85
2011	35.64	39.42	15.33	15.75	15.92

Source: Statistics Norway/Climate and Pollution Agency

1. Summary

The statistical differences in the energy balance are the main reasons for large differences between the reference and the sectoral approach in the Norwegian emission inventory. As a response to the Saturday paper from the in-country review in the fall of 2012, an action plan was developed. The aim of this action plan was quality controls of important data sources and calculations within the energy balance and, if possible, reduction of the statistical differences for dominant energy products.

There is a close cooperation between the producers of the energy statistics and the emission inventory compilers in Statistics Norway, and the requirements of the emission inventory are continuously taken into account in the production of the energy balance. Considerable resources are allocated to the production of the energy balance and the emission inventory and appurtenant improvement projects every year. Allocations are however always a result of priorities between different needs and demands.

The quality controls of the energy balance, pursuant to the action plan presented to the expert review team (ERT) in November 2012, have included examinations of both the supply side (roughly comparable to the reference approach) and of the consumption side of the energy balance (roughly comparable to the sectoral approach).

The *supply side* has been examined through contact with the Norwegian Petroleum Directorate (NPD) and the Division for external trade at Statistics Norway. The production data are found to be of high quality. NPD also possesses detailed data on shipments, from which export data can be extracted. The NPD export data have been found to be consistent with the production data.

The external trade statistics (ETS) data on petroleum export consists of several data sources, which need to be sewed together. It has earlier been demonstrated that shipping agents misclassify petroleum products. This may lead to under- and over-coverage in the ETS export, which in turn causes statistical differences. There are also examples that new fields and pipelines have been missing in the ETS export. This illustrates the risk when data for new facilities are not automatically included in the ETS input data.

We recommend a project to be set down to evaluate the NPD export data as an alternative data source for unrefined petroleum products (excl. natural gas transported by the Gassled system) in the ETS, in order to avoid these inconsistencies and automatically cover new facilities.

On the *consumption side*, the statistics on energy use in the manufacturing sector has been controlled by comparing input data from individual entities with energy consumption figures from the same entities reported to the Climate and Pollution Agency in the annual report as required under the EU emission trading system and under the regular permits. The overall consistency and coherence with this other data source is acceptable.

The statistics on deliveries of petroleum products have undergone changes in the methodologies for the annual petroleum statistics. Previously, annual figures were based on adding up the monthly figures. In the pilot project, Statistics Norway collected additional annual information from the oil companies to help improve the quality of placing the deliveries into the correct purchaser groups. When the total volume in the annual and the monthly figures were compared, there were only small differences in the figures. In the monthly figures for 2012 total sales amounted to 9.488 billion litres. In the annual figures the total deliveries came to 9.555 billion litres.

Data on energy goods used as raw materials are collected annually from the largest consumers, with a more complete survey on use of raw materials in all manufacturing industries being carried out less frequently. The latest thorough survey carried out for the reference years 2009, 2010 and 2011 has been used as a quality control for the raw material figures used in the energy balance, and the control did not reveal any significant use of energy as raw materials not already covered in the energy balance.

Although comprehensive quality controls have been performed during the past few months according to the action plan, *further work* is still needed. This primarily concerns the supply side of the energy balance, where further work on export figures needs to be performed. In addition, a project to improve consistence with the national accounts is in the planning phase, and an improved production system of the energy balance is under development. This will result in a more robust system and increased transparency. More focus on cooperation between divisions at Statistics Norway will be developed as a result of this and other ongoing projects. Such cooperation will contribute to better statistics and reduced statistical differences.

Statistics Norway maintains the position that a large statistical difference relative to national consumption is not unreasonable in Norway, given the large production and export share. This project has not revealed any major shortcomings of the consumption data of the energy balance, and it is likely that the main sources of statistical differences are to be found on the supply side of the equation. It is not feasible to set a fixed level of statistical difference that is considered acceptable. It could be determined as a percentage of production or consumption, but the actual level will depend on the production, export and consumption level, and the relationship between them, for each energy product. The level of statistical difference will continue to be evaluated, but it is unlikely that a strict rule can be determined.

2. Introduction

During the in-country review of Norway in the autumn of 2012, the review team raised the issue of the difference between the sectoral approach (SA) used to estimate the CO_2 emissions in the energy sector and the reference approach (RA) for most years, with the RA for most years being higher than the SA. Thus, the ERT stated that the RA calculations for Norway might indicate an underestimation of CO_2 emissions from the energy sector, rather than serving as a verification of the emission estimates. This led the ERT to the conclusion that Norway has not met the mandatory requirements in accordance with the Guidelines for National Systems, and the issue was raised in a Saturday paper during the review.

In response to this, Norway presented by November 1st 2012 an action plan with the aim of reducing the statistical difference in the energy balance, and performing a thorough quality control of the energy balance. Considerable human resources have been reallocated from other planned activities in order to follow up the action plan presented as a response to the Saturday paper. The ERT found that the action plan formed a good basis for resolving the potential problem, but raised a concern that a not fully implemented plan, and/or not well justified results in the next annual submission, would mean that the underlying problem persists. The ERT strongly recommended that Norway report on the outcome of the action plan and the specific results of all the QC checks carried out for both the reference and sectoral approaches in the 2013 NIR. This document is a response to this recommendation.

The production of primary energy carriers, like crude oil and natural gas, in Norway is about 12 times higher than the domestic consumption. Therefore, an error in total production and/or export data of 1 per cent will lead to a statistical error of about 12 per cent the size of the domestic consumption figures. Hence, we anticipated that main source(s) of the statistical difference was to be found at the supply side. The action plan has, however, focused on both sides of the equation, looking for discrepancies in activity data and methodologies both on the supply and use side.

Many sources of data and information have been examined in this project in order to evaluate the causes for the large statistical difference in the energy balance. In previous projects, only errors found have been systematically documented. This project has aimed at also documenting where errors have not been found. For information on historical corrections, see e.g. Evensen (2006), Walle et al. (2006) or Vesterås (2012, in prep.), and descriptions of these corrections presented in earlier submissions.

Although we have performed considerable amounts of quality controls of both the supply and consumption side of the energy balance within the past few months, our work is not finished. The last chapter of this document describes an outline of areas of further work. However, the project has strengthened our understanding that the data on consumption and production in the energy balance are of good quality, and that the main challenge lies within the quality and delimitations of export figures.

2.1. Relation between sectoral approach, reference approach and statistical difference

The following set of equations describes the relations between domestic consumption according to the reference approach (RA), the sectoral approach (SA), the statistical difference (SD) between the two approaches and the different data sources involved:

1. SD = RA – SA + secondary production – transformation – losses
2. RA = production + import – export – bunker oil ± stock changes
3. SA = end use + use in energy sector + flaring + transformation which gives emissions

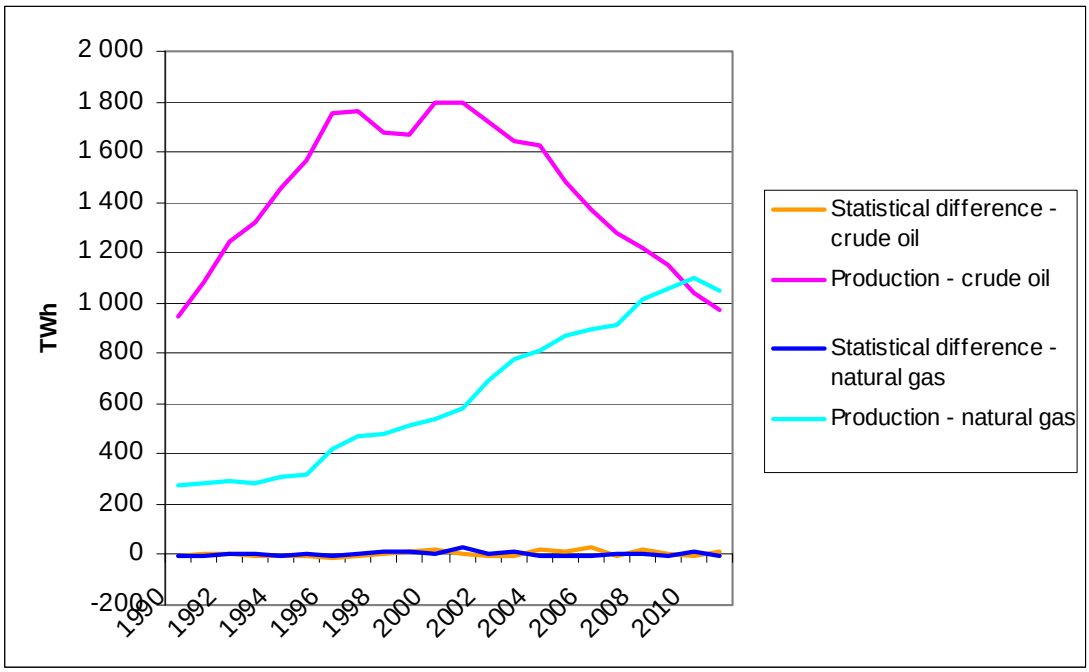
The elements in these relations displaying the highest amounts of fossil energy carriers, are by far production and export, and then end use. Looking at those elements therefore made a natural starting point for searching for statistical differences. The main data source for end use is the statistics on delivery of petroleum products, which has been investigated in this project.

3. State of the statistical difference and effect of corrections

During the review, the ERT noted that there seemed to be a considerable change in the statistical differences around 1999/2000, and suggested that this would be a good place to start looking for abrupt changes in methodologies or activity data. Such changes could possibly aid us in finding the reasons for the large statistical differences later in the time series as well. During the quality controls performed during this project, one issue has been the examination of possible structural or methodological changes taking place during this time period (see chapter General quality controls). However, the base statistics of the energy balance are not governed by the same rules of time series consistency as the emission inventory, and it has thus not been feasible to perform detailed quality controls of the data sources for this time period within the frames of the project. This work has thus primarily focused on the latest years of the time series.

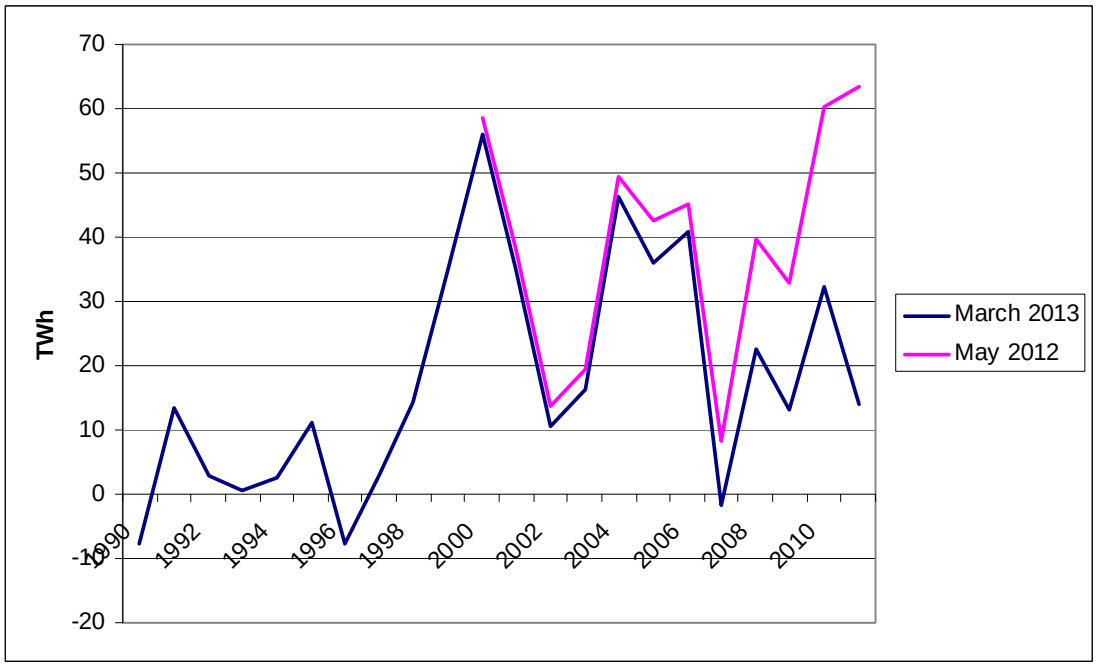
Norway is a large energy producer and exporter of energy. We have been producing 10-12 times more energy than what we use as final consumption. Due to that, it is most relevant to study the statistical difference as a share of production. On average, the total statistical difference has made up 1 per cent of primary production in the period 2000- 2011. In the period 1990-1999 it was 0.3 per cent as a percentage of primary production. In the period 1990-2011, the statistical differences have been negative only 3 times, which indicate a systematic overestimation of supply and/or underestimation of consumption. Thorough investigation of the figures indicates that something may be missing in the exports figures, specially the figures which are based on custom declarations, such as NGL/LPG products and naphtha/condensate. Statistical differences for crude oil and natural gas are now not higher than about 1 per cent (after some recent corrections in export figures), and for several years, it fluctuates also below zero (Figure 11).

Figure 1: production and statistical difference for natural gas and crude oil, 1990-2011. TWh.



During the examinations of the different data sources in the energy balance, some errors have been corrected. Figure 2 presents the current overall statistical difference in the energy balance, compared to the statistical difference from the energy balance published in May 2012.

Figure 2: overall statistical difference, 1990-2011. TWh.



The lion's share of the corrections has been made within export figures:

1) The external trade statistics (ETS) has recorded export of rich gas (which in fact consists of NGL products, condensate and some dry gas) as exports of dry gas only. Since in NGL has a higher energy

content than dry gas, the net total export of energy becomes underestimated. A correct recording of this export in the energy balance lead to an increase in net export of 4-6 TWh per year on a total level.

2) Exports from certain oil and gas fields were omitted from the ETS for the years 2010-2011. This made up 3,5 TWh and 4,3 TWh for crude oil, and 17 and 11 TWh for natural gas, for these years respectively.

3) Due to some issues that remain to be resolved in the ETS, the export figures for condensate have been underestimated the recent years. In the energy balance, we have therefore used the Norwegian Petroleum Directorates export figures for export, which we think are more correct as they match the production figures better. These have annually been about 18 TWh higher than the figures in the ETS. By May 2012, these figures were already implemented in the energy balance for 2010, but not for 2011.

4) Some of the improvements for 2011 are also due to the fact that the energy balance figures published May 2012 were based on preliminary figures, which were later revised. Coal export for 2011 increased for instance by almost 3 TWh due to revisions in the ETS.

Previously, the LPG use in energy transformation has been underestimated by approximately 3 TWh annually. Note that the change in LPG transformation has no effect on the reference or sectoral approaches in the greenhouse gas reporting to the UNFCCC, even though the statistical difference is improved. In general, changes in the energy balance flows *transformation* ('secondary consumption ') and *secondary production* that do not entail combustion, i.e. relation 1 above, are not included in any of the two approaches. The reference approach is only affected by changes on the supply side. The sectoral approach is affected by changes on the consumption side, including consumption in the energy sectors and transformation that entail combustion. One might say that the reference approach focuses on a point in the product flows upstream of transformation, while the sectoral approach focuses on a point downstream of transformation.

As a result of these and some other minor corrections, statistical difference dropped totally by 49 TWh in 2011, to about a quarter of the original size, and by 28 TWh in 2010, to about half the original size, compared to figures published in May 2012.

In addition, a new post has been introduced in the energy balance, showing conversion of NGL/LPG to fuel gas. This helps making the energy balance more transparent.

4. Institutional arrangements

Statistics Norway holds the overall responsibility for the level of the statistical differences in the energy balance, and has led the work with quality controls and contact with other institutions. However, because of the importance of the energy balance in the national emission inventory, the Climate and Pollution Agency has also been involved in the process of quality controls. The work has also included contact with divisions outside the Division for energy and environmental statistics, in particular the Division for external trade.

Financial resources have been provided by the Climate and Pollution Agency and Statistics Norway in a joint venture.

The action plan presented in November 2012 described a division of work into several groups. These groups have been established, although with somewhat different mandate and composition than foreseen because it, during the course of the work with the action plan, has been considered more appropriate this way. The different tasks within the action plan has been partly undertaken within the

working groups and partly by more informal contact between personnel at the Division for energy and environmental statistics at Statistics Norway and relevant collaboration partners.

4.1. Liaison group

A liaison group was established, whose main purposes were to allocate resources, supervise and coordinate the overall progress of the project. It has had the overall responsibility for the allocation of financial and human resources for the work with reconciling the reference and the sectoral approach. It has been considered most appropriate to expand this group to include both heads of division and executive officers, and the group has discussed the allocation of resources, progress towards fulfilling the action plan and the preliminary results of the project.

4.2. Statistics Norway working group

A working group in Statistics Norway has coordinated the tasks related to evaluation of the consistency of the official statistics on energy, external trade, and emissions. The contact has been mainly performed by informal contact at the level of executive officers, after the establishment of collaboration for this particular project by heads of divisions.

The working group at Statistics Norway has coordinated the comparisons of different statistics and data sources. In the action plan it was planned that the group would consist of members of three different divisions. However, the contact has mainly been between the divisions of external trade and the division for energy and environmental statistics, both at the level of heads of divisions and between executive officers. The rationale for this has been that the focus mainly has been on data quality and delimitations, and the Division for national accounts is to a large extent a user of the two statistics. Increased contact with national accounts is planned in the near future, see chapter “Further work”.

4.3. Reference and sectoral approach groups

The quality control of the reference approach and the sectoral approach has been performed by contact with relevant institutions, both in the form of formal meetings aimed at improving data flow and formal agreements, and informal contact between personnel responsible for the different statistics at Statistics Norway and relevant personnel at other divisions and institutions.

There have been two meetings between the Norwegian Petroleum Directorate (NPD) and Statistics Norway during this time period, one in December and the other in February. The aim of these meetings was to get updated formal agreements in place on data processing and data flow between the two institutions, and to develop a joint understanding of the challenges related to consistency in production and export figures. The first meeting was a joint meeting between the divisions for external trade statistics (ETS), manufacturing and R&D statistics, and energy and environmental statistics at Statistics Norway and the Norwegian Petroleum Directorate, while the second meeting took place in Stavanger and was a meeting specifically between the Norwegian Petroleum Directorate and the Division for energy and environmental statistics.

It has not been deemed necessary to establish a formal collaboration with the Directorate of Customs and Excise (CED) for this project, as the Division for external trade statistics already has this collaboration and participated actively in the project.

The quality controls for the sectoral approach have been performed through informal contact with external contributors, such as the oil companies. The statistics on deliveries of petroleum products are in the process of undergoing considerable alterations in methodologies, and an informal contact with

oil companies have been part of this process. The need for a collaboration meeting with all oil companies will be evaluated by the end of the improvement project for this statistic.

5. General quality controls

It has been observed that the statistical difference in the energy balance seems to increase in the 1999-2000 time period. The basic data are not necessarily subject to requirements of time series consistency, and the time series may thus be affected by changes in methodologies or data availability. In addition, the history of oil production in Norway has been subject to many changes over the years, which may also have affected the completeness of data on production and exports/imports. Thus, as part of the quality controls and contact with the Norwegian Petroleum Directorate (NPD) in particular, we have also been on the lookout for changes during the 1999-2000 time period, which might have led us in the direction of disentangling the statistical differences.

We have not been able to single out particular alterations that may explain the apparent jump in the statistical difference time series within neither the reporting from the oil companies to NPD on oil and gas production, the reporting from the oil companies to Statistics Norway for the statistics on deliveries of petroleum products, nor the handling of data sources in the energy balance and the external trade statistics (ETS). The reporting of the oil companies to both NPD and Statistics Norway is of high quality. However, the establishing of Gassco AS medio 2001 coincides with a peak statistical difference for natural gas the same year. Gassco AS took over the operatorship of most Norwegian gas pipelines from 1/1-2002, and thus getting data from and contact with the different operators of 2001 may have been more difficult after they ceased to be operators 1/1-2002.

The timing of introduction of new flows, e.g. new pipelines or terminals, and important organisational changes within the oil and gas industry have not been extensively studied. There are some obvious historical events taking place in the time period in question. New fields routing the well stream directly to facilities abroad via new pipelines have caused major statistical differences the last few years, as not all of them have been covered by the ETS. These shortcomings have now been corrected, and the corresponding statistical difference eliminated.

Another event having a potential link to statistical differences is the production of *Åsgard blend* from 2007. Åsgard blend is a mix of heavy crude oil and condensate, in order to make the oil lighter. Before 2007 there was a condensate storage on the Åsgard platform, and the condensate was sold as a separate product. From 2007 condensate from Åsgard and several new satellite fields were mixed with and sold as crude oil. At the same time the statistical difference for condensate started to increase. See subtitle ‘Condensate’ for more details.

The mixing, and hence classification, of condensate as crude oil is particularly interesting due to an estimation method used in the ETS (which we will get back to) that poses a risk of loosing exports of condensate if misclassified. Mixing condensate with, and selling it as, crude oil has become increasingly common during the recent years, also for fields outside the Åsgard area.

Another event is the introduction of an important transport and processing system for NGL and condensate in 1999. We have, however, not seen any obvious links between this historical event and the level of statistical differences.

5.1. Stocks

An examination of stocks of energy products, e.g. crude oil, coal and coke, as well as energy goods used as raw materials, has been performed as a part of the overall check for completeness. Data on stocks of crude oil on fields and terminals are received by Statistics Norway from NPD, which in turn

receive the figures from the oil companies. According to NPD, the quality is acceptable. For coal and coke Statistics Norway collects stock figures from the largest consumers of coal and coke in Norway, and from the only coal producer. Regarding the coal stocks from the coal producer, these sometimes include stocks abroad, and sometimes not. Efforts have been made to make the time series for stocks more consistent, with stocks abroad excluded.

It could also be mentioned that the producer's coal stocks can be large, as export by boat is not possible in the winter season (approximately half of the year) due to ice.

5.2. Energy goods used as raw materials

Energy goods used as raw materials consist mainly of coal, coke, petroleum coke, LPG and natural gas used for non-energy purposes. We collect energy used for these kinds of non-energy purposes annually from the largest consumers. There may in addition be some smaller industries that use small amounts of energy for non-energy purposes. A more complete survey on use of raw materials in all manufacturing industries, are carried out less frequent. This kind of survey was recently conducted for 2009-2010, and this survey did not reveal any significant use of energy as raw materials not already covered in the energy balance, only small amounts that were of minor importance.

6. Quality controls of the sectoral approach

The consumption side of the energy balance is mainly covered by the following data sources:

- Statistics on the deliveries of petroleum products
- Statistics on energy use in the manufacturing industries (for other products)
- Statistics on combustion in the energy producing industries
- Statistics on domestic use of natural gas

The focus of this quality control project has been on the statistics on deliveries of petroleum products ("sales statistics") and the statistics on energy use in the manufacturing industries. The rationale for selecting these two statistics for extra quality control was their importance as data sources in the energy balance and actual possibilities for performing such controls.

6.1. Statistics on deliveries of petroleum products

Statistics on deliveries of petroleum products is one of the most important data sources for the energy balance. A pilot project to improve quality of the statistics was implemented in 2011. The result was promising and led to changes in the methodologies for the annual petroleum statistics.

Statistics Norway receives and publishes monthly figures for deliveries of petroleum products. The sources are the largest oil companies that operate in the Norwegian market, and import figures. The data received from the oil companies contain figures on monthly sales of petroleum products, divided into company, products, purchaser group, region, month and year. The figures are given in litres. The reporting oil companies are responsible for placing the deliveries in the right purchaser groups. There are uncertainties regarding the quality of the data received from the oil companies, especially the allocation to purchaser groups.

Previously, annual figures where based on adding up the monthly figures. In the pilot project, Statistics Norway collected additional annual information from the oil companies to help improve the quality of placing the deliveries into the correct purchaser groups. In addition to the information that are collected monthly, the companies were instructed to send detailed information for every delivery. By using the oil companies customer records, every delivery were connected to an organisation

number. In the Norwegian Business register, the organisation number is connected to a code for classifying industrial activity (nace). The over 800 nace codes produce detailed information about what kind of business activity the buyer is involved in. From this information the statistics for deliveries of petroleum products can place the deliveries into the 34 purchase groups with higher accuracy. If more detailed information is required, a new and extended definition of the purchaser groups can be establish based on the 800 nace codes.

When comparing the total annual and monthly volumes, only small differences were observed. In the monthly figures for 2012 total sales amounted to 9.488 billion litres, compared to 9.555 billion litres in the annual figures (i.e. 0.7 per cent higher).

6.2. Data reported from the petroleum companies

One of the main problems with the quality in the statistics for sale of petroleum products have been that the reporting oil companies have difficulties in the distinguishing between the purchaser groups when they are reporting to Statistics Norway. The problem is especially noticeable within the purchaser groups: domestic navigation, foreign navigation, petroleum exploitation, fishing, government/local government and private enterprises.

Pilot projects indicate that access to additional detailed sales data from the reporting companies increase the quality of the statistics (Isaksen et al. 2012). The total sale of the different petroleum products did not change considerably by using the additional information. Using extra information in the customer registers will however enhance the quality of the sales statistic within purchaser groups and geographical spread, and therefore improve the input data to energy balances, energy accounts, national accounts and the emission statistics at a more detailed level.

6.3. Using refinery data for verification purposes

During the preparation of the action plan, it was considered a possibility to use refinery data to verify the statistics on deliveries of petroleum products. The idea was that figures for refinery output, adding imports and subtracting exports might give an indicator of inland consumption for some petroleum products:

Refinery data + external trade = deliveries of petroleum products

However, this relation does not represent a good tool for quality control of the deliveries (sales) of petroleum products, due to inconsistencies in product classification, physical units and periodicity. We have thus not continued the search for quality controls down this line.

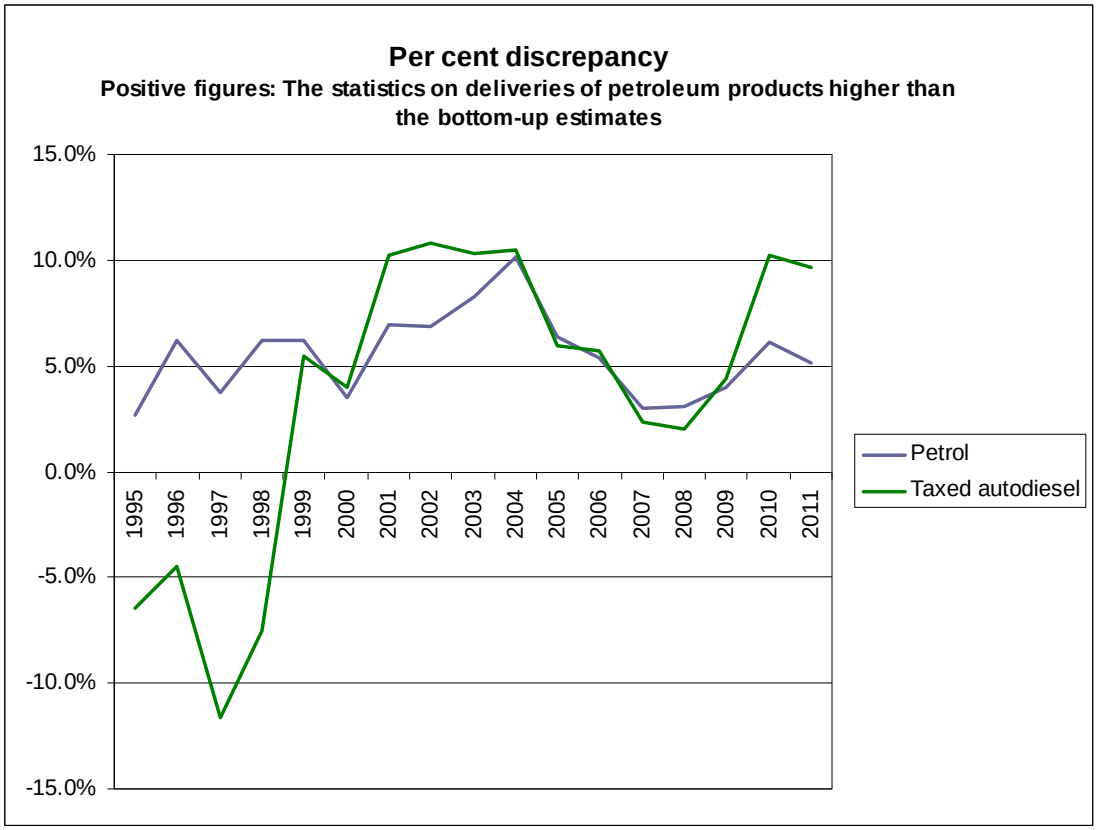
6.4. Bottom-up estimates for road transport

Road transport is one of the few areas where we have the possibility of directly checking data with alternative data sources. The road transport model used to calculate emissions from road transport also estimates fuel consumption using activity data on number, age and type of vehicle and driving lengths. A complete match with sales figures are not to be expected, but if calculations from the road model were consistently higher that the figures from the deliveries of petroleum products, this could indicate under-coverage in the petroleum statistics.

As Figure 3 shows, the figures from the sales statistics lies well over the bottom-up calculations from the road model from 1999 onwards. This would indicate that the sales statistics does not underestimate to deliveries of these energy products during this time period. For taxed auto diesel there are some issues for the 1995-1998 time period, because the introduction of taxation of auto diesel for road

transport was not complete until 1999 (Norwegian Customs 2012). Buses were until then allowed to run on tax-free diesel, and the consumption for this purpose has been adjusted in the energy balance.

Figure 3: discrepancy between bottom-up calculations for road transport and petrol and taxed auto diesel figures from the statistics on deliveries of petroleum products, 1995-2011. Per cent.



6.5. LPG - especially challenging

For LPG there are known shortcomings of the statistics on deliveries of petroleum products ("sales statistics"). Statistics on sales of petroleum products is not a good source for inland consumption of LPG. Over 60 per cent of the sales are registered as used in the industry sector, while the rest is spread almost equally over the other sectors. The overall sale do not cover all the inland consumption. Hence, consumption data for energy and non-energy purposes collected from manufacturing industries is used as data on LPG usage in the energy balance.

6.6. Statistics on energy use in the manufacturing sector

The statistics on energy use in the manufacturing sector has been subject to extra quality control. The completeness of the statistics has been examined through comparing input data on individual industrial entities with data reported to the Climate and Pollution Agency through the system of annual reports as required under the EU emission trading system and under the regular permits.

We have used energy data collected by the Climate and Pollution Agency to examine the quality of the statistics on energy use in the manufacturing sector. The biggest units were controlled with an emphasis on energy and emission intensive energy products. The overall consistency and coherence with this other data source was good. There were only a handful units that may have potential errors

and that we need to pay extra attention to when editing the data. These potential errors are not large enough to significantly influence on the statistical difference in the energy balance.

The consistency between the figures on the use of oil products was very good. There was only one exception where it seems like the statistics on energy use in the manufacturing sector had one missing entity in the consumption of waste oil. The Climate and Pollution Agency collects natural gas in gaseous form (NGG) in a different physical unit than Statistics Norway does, and it is somewhat challenging to determine whether the gas is used for fuel or raw materials (for products or electricity). Despite this, there are no large differences in the data sets. The figures for propane and butane (LPG) and liquefied natural gas (LNG) figures are very comparable and consistent. The coherence of the gas figures has also been checked against the sales statistics for the domestic use of natural gas.

Some of the biggest industrial entities of auto diesel consumption are missing in the data reported to the Climate and Pollution Agency. An explanation of this may be that some companies only report the emission, and not the actual use in physical units. The datasets are therefore not very comparable when it comes to auto diesel.

There are few companies that use self produced or purchased CO-gas, fuel gas and refinery gas. Some of these companies have electric utilities as an integrated part of the production facilities. The comparison of input data to the statistics of energy use in the manufacturing sector and the energy consumption data reported to the Climate and Pollution Agency revealed that these entities need to be examined with extra care when the statistics are compiled. Even though the gases are collected in different physical units, the dataset from the Climate and Pollution Agency provides an important quality control of the figures.

Some of the biggest industrial users of coal and coke products are missing in the data sets from the Climate and Pollution Agency. This may be because some of the biggest users of coal are not included in the international systems for quota trading. The figures from the companies that the two data sets have in common are almost identical, except from some missing figures for petrol coke in the input data to the statistics on energy use in the manufacturing sector. It is not clear if these potentially missing figures are used for fuel or raw materials. This will be controlled and if appropriate corrected in the next update of the statistics.

7. Quality controls of the reference approach

The reference approach is the area where we anticipated finding the major causes of the statistical difference. There has previously been much work done in this area, as described in the NIR in 2012 (Climate and pollution agency 2012) and at the review the same year, and we have continued the search for errors here.

7.1. Production and export data from the Norwegian Petroleum Directorate (NPD)

During this project there has been extensive contact between the Norwegian Petroleum Directorate (NPD) and Statistics Norway, and we have had thorough discussion on the quality controls performed at NPD of production and shipment data reported by the oil companies.

NPD collects data on both production and shipments of petroleum products electronically from the oil companies on a daily basis. The production data displays amounts by field, month and product. The shipment data displays each single shipment, including its destination. Shipments with destination outside Norway are called NPD export in this document.

The data are used amongst others by the tax authorities for fiscal purposes, by the oil companies to get information on own and other companies' production, and Statistics Norway. The measuring quality is regulated by law. Measuring device need to be officially approved, and spot checks of measurements are performed. Maximum allowed random measuring uncertainty on single shipments is 0,3 per cent. Biases are not allowed. Thus, when summing up over a year the measuring uncertainty is negligible.

NPD and the different users of the data have mutual interest of getting as good data quality as possible. NPD administers and publishes the data, and would be interested in displaying correct data for that reason. They perform monthly controls of the data per field and product, against prognoses for the same fields. Also, the production and NPD export data are balanced against each other, and the shipments of natural gas are controlled against similar data from Gassco AS. The authorities will seek to get a best possible basis for collecting taxes from the oil companies, which is the reason for the mentioned measurement regulation and spot checks. The oil companies, on their side, want to avoid paying too much tax, and they also want to control the amounts reported by the other oil companies to assure that their share in the oil field is correct. Statistics Norway perform data control in order to make reliable statistics.

Moreover, the shipment data contains information identifying each single delivery (cargo number, shipment date, owner, destination country, etc.), which can be used for detailed quality checks. In sum this represents a very thorough quality control of the production and NPD export data.

The (net) production data and the NPD export data are measured at the delivery point. There is a minor time lag, as production is measured per month while NPD export is measured at the shipment day. Because of the ship size (typically 20 to 150 thousand metric tonnes, or about 0.5 – 2 TWh) this time lag causes a little difference ('stock change') between the total amount in the two data sets. However, over time this difference fluctuates around zero.

In case the two NPD datasets classify a petroleum product differently: The production at four fields, landed at the same Norwegian terminal, that is classified as NGL in the production data, is in the shipment data classified as condensate. Destination country is Norway, and therefore this inconsistency does not cause any statistical difference.

NPD has during the project confirmed that no other cases of inconsistent classification between in the two NPD datasets exist.

The shipment dataset contains information on origin and destination of the first delivery in the delivery chain, but does not trace the product streams beyond that. Origin in this case refers to site of shipment (i.e. production field or terminal).

Statistics Norway gets data from the NPD for the final energy balance in September/October.

7.2. Export data in the external trade statistics (ETS)

The ETS export data on crude oil and on natural gas transported by pipelines outside Gassled are collected from the oil or gas companies. as are the NPD export data. The only structural difference in the data is that oil being landed in the UK has UK as *destination* in the ETS export data, while UK is *origin* in the NPD export data. Data on natural gas transported in pipelines are collected from Gassco AS, whose data corresponds well with the NPD export data. Natural gas landed in UK has the same difference in the definition of origin vs. destination as oil. For the other petroleum products custom declaration data from the Directorate of Customs and Excise (CED) are the data source.

There are several occurrences of crude oil and natural gas shipments being custom declared, and to avoid double counting these declaration data are removed from the final dataset and placed in a rest database. The figure below gives a schematic picture of the different data sources, as well as effects on the statistical differences in case of product misclassifications.

Figure 4a: ETS[1] export database – data sources by product

Crude oil	**Medium distillates (crude) and LNG**	**Natural gas**
Oil companies (operators) *HS code: 27090009*	Directorate of Customs and Excise (CED) *HS codes:* *- 27090001* *- 27101191/27101291* *- 2711xxxx (excl. 27112100)* *- 29011000*	Gassco AS (Gassled) Gas companies (other) *HS code: 27112100*

Rest database (crude oil)	***CED data to rest database, in order to avoid double counting***	**Rest database (natural gas)**
Directorate of Customs and Excise (CED)		Directorate of Customs and Excise (CED)

Figure 4b: ETS[1] export database – effect of product misclassifications

Crude oil	**Medium distillates (crude) and LNG**	**Natural gas**
No effects	***Positive statistical difference*** if crude oil and natural gas are misclassified as medium distillates or LNG	No effects

Rest database (crude oil)	*CED data to rest database, in order to avoid double counting*	**Rest database (natural gas)**
Negative statistical difference if medium distillates are misclassified as crude oil		***Negative statistical difference*** if medium distillates and LNG are misclassified as natural gas

Refined petroleum products (HS 2710xxxx, excl. 27101191/27101291)
Positive statistical difference if crude oil and natural gas are misclassified as refined petroleum products. ***Statistical differences that balance at a total level*** if crude middle distillates are misclassified as refined petroleum products.

1 External Trade Statistics

The different input data on petroleum products in the ETS export are very important for several reasons, as the economical values involved are enormous. It must therefore be believed that the data, at least for economical (i.e. tax or custom) purposes, are of high quality. However, there are some

elements in the data collection and processing that might impair the data quality for statistical use, and hence give rise to statistical differences:

1. Data on the different products are collected from fundamentally different sources, and need to be sewed together (see figures above). Misclassification of products may therefore lead to loss or excess of data, for instance if condensate is misclassified as crude oil or vice versa. In the ETS export data products are classified by Harmonized system (HS) codes. The HS codes for petroleum products have quite technical description texts, and products that look similar may belong to different codes. It has been demonstrated that shipping agents, who are responsible for the classification in the CED data, sometimes make mistakes when classifying petroleum products (Walle et al. 2006, p. 43-44). The situation is further complicated by the fact that condensate is sometimes sold and classified as crude oil (f. ex. Åsgard blend), and that this practice has changed over time.
2. New pipelines going directly to foreign destinations are not automatically included in the ETS export data. There are examples that such pipelines have been missing in the ETS .
3. Some petroleum streams have different measuring points in the production and the ETS export, i.e. unstabilized crude oil and rich gas landed in UK. In the energy balance there has been established methods for splitting these two streams into the different petroleum products as reported from the NDP. However, detecting any new pipelines of the kind requires high expertise, and the difference in measuring point therefore represents a risk of inconsistency between the production and the ETS export.

The final ETS export (and import) figures are released in May the next year. Any corrections reported from the oil companies to the NPD data after that time will not be implemented in the ETS data. This is another potential source to statistical differences, and calls for early (March-April) and coordinated revision routines among the affected statistics.

The form of the data is different from the NPD export data, and hence they are not easily controlled against each other. With some investigation detailed comparisons can be made to get a brief idea of the quality in the two data sources (see below). However, the comparisons are tedious and insufficient for routine controls.

The ETS and NPD data are, except for unstabilized crude oil and rich gas landed in UK, measured at the same point, i.e. the delivery point[1].

The work on quality controls of the export data will continue towards the 2014 submission, see chapter “Further work”.

7.3. Comparison of export data from the external trade statistics (ETS) and the Norwegian Petroleum Directorate (NPD)

Comparisons of export data from ETS and NPD may give answers to possible omissions in the export figures used in the energy balance, but the task is very time consuming. It is therefore not feasible to perform this task for every shipment within the years with large statistical differences. However, it was deemed necessary to examine exports at such a detailed level in order to evaluate possible systematic errors in the external trade statistics used in the energy balance. We have therefore performed a case study, comparing single shipments from 01.2010. The data applied cover both the month before and the month after, so that shipments from the selected month may be matched also in the case of time lags between the datasets.

[1] When it comes to transportation costs, the measuring point in the ETS is at the national border.

In the case study we focused on the following products: Crude oil, condensate, isobutane and LNG. Natural gas in gas form was not selected, since the basic data and the data source are the same. For this product coordinating data collection and revision in Statistics Norway should be sufficient to eliminate inconsistencies.

The following variables were used in the comparison if present in the ETS data: Cargo number (crude oil lifted by tanker only), owner company (all but pipeline transported crude oil), shipment date, destination country and product amount.

General findings
With some investigation it was possible to make a good comparison between the NPD shipment data and ETS export data containing cargo number (i.e. crude oil lifted by tanker). For the other products detailed comparison was difficult or impossible due to scarce information on the ETS datasets. The reason why investigation was needed was:

- Though recognizable, the cargo numbers were typed in different ways and could not be matched automatically.
- Some loads had been split and merged.
- Some loads were registered on different dates, and some times even in different years (around new year).
- Some loads were registered on different destination countries. This could typically be the case if the load went through a transit country.

Crude oil
The ETS dataset on crude oil lifted by tanker showed a good consistency with the NPD shipment data. All 69 shipments by tanker registered by NPD as export in the selected month were found in the ETS data, and all but two in the ETS export data was found in the NPD export data. The two shipments amounted to 102 thousand tonnes, and a time lag of more than one month could be an explanation.

Crude oil exported by pipeline showed poor consistency between the two datasets for the selected month, but improving when the month before and after was included in the comparison (table 1).

Table 1: Crude oil products landed in UK, by month. Thousand tonnes.

	ETS	NPD	
Period	**Unstabilized crude oil**	**Stabilized crude oil**	**Other fractions[1]**
12.2009	1 429	1 567	36
01.2010	*1 435*	*1 081*	*36*
02.2010	1 289	1 701	28
Total	***4 153***	***4 349***	***100***

1 Ethane, propane and butane. Re-import to Norway, amounting to 32 thousand tonnes over these three months, is included.

When unstabilized crude oil in the ETS is compared with the NPD data on stabilized crude oil and the fractions purged out when stabilizing the oil (ethane, propane and butane), data for all three months show a somewhat higher amount in the NPD data (4 449 vs. 4 153 tonnes). Due to huge monthly variation, especially in the NPD amounts, this aggregated comparison can not be used to identify the relatively small statistical differences,

A detailed comparison was however impossible, as 1) owner company was not registered on the ETS dataset 2) all shipments had UK as destination country in the ETS data, while UK was the origin country in the NPD dataset, and 3) shipments were displayed with different level of aggregation in the two datasets. Additional information would be necessary to perform a meaningful comparison on a detailed level.

Therefore, no final conclusions can be drawn about the sources to statistical differences in crude oil amounts, but shipments by tanker show rather good consistency between the two datasets.

Condensate
Condensate shows poor consistency between the two datasets. There are some additional difficulties when comparing this product:

- Condensate (HS code 27090001) sometimes seems to be classified as naphtha (HS code 27101191) in the ETS
- Although naphtha is more close to gasoline in the NPD datasets.
- Some condensate is produced from a rich gas stream that is all counted as natural gas in the ETS, but as its fractionated products by NPD. In these cases no match will be found.

Accordingly, condensate, naphtha and gasoline must be viewed together:

Table 2: Condensate-like products, by month. Thousand tonnes.

	ETS		**NPD**	
Period	**Condensate**	**Naphtha**	**Condensate[1]**	**Gasoline**
12.2009	3	68	314	60
01.2010	*175*	*257*	*249*	*61*
02.2010	39	203	260	53
Total	***217***	***528***	***823***	***174***

1 Condensate from rich gas, amounting to 41 thousand tonnes over the three months, is included.

On an aggregated level the amount of condensate and naphtha in the ETS export amounts to 745 thousand tonnes over the three months, while condensate and gasoline in the NPD export adds up to 997 thousand tonnes. One main cause of the difference therefore seems to be time lag, as the ETS export varies greatly over months. A smaller part of the difference, 41 thousand tonnes, is due to different measuring point for one rich gas stream.

There was found very few matches on a detailed level, and shipments from one Norwegian terminal was not found at all. Cargo number is not present on the ETS dataset, and therefore splitting and merging of loads in the ETS dataset could not be
traced. This was further complicated by the fact that the allocation of shipments to destination country seems to be somewhat different in the two datasets. Additional information would be necessary to perform a meaningful comparison on a detailed level, including declaration number and a link between cargo number and declaration number.

Isobutane
According to the NPD export data for the selected month, all isobutane was shipped from one terminal but by several owners. In the ETS export data isobutane from just one owner was registered. Three shipments were found in both datasets, one in the ETS data only and 16 in the NPD data only. The total amounts were 9 and 30 thousand tonnes in the ETS and NPD export data respectively. Similar findings were made for both neighbouring months.

This suggests a positive statistical difference in NGL/LPG in the energy balance, due to under-registration or misclassification of isobutane in the ETS.

LNG
Parts of the shipments in the NPD dataset are given in Sm^3, and not in tonnes. These were converted to amounts in tonnes by using the average 2010 natural gas density of 0.0007519 tonnes per Sm^3, based on Norwegian net production data. An aggregated comparison is given in table 3.

Table 3: LNG, by month. Thousand tonnes.

Period	ETS	NPD[1]
12.2009	135	137
01.2010	*300*	*387*
02.2010	288	259
Total	***723***	***783***

1 Parts of the data were converted from Sm^3 based on a density of 0.0007519 tonnes per Sm^3.

A complete detailed comparison was not possible, as parts of the NPD data were given in Sm^3 only and had to be converted by applying an average density. Since many of the shipments were of similar size, and because of the use of transit countries, a such detailed comparison would be too uncertain for the purpose of finding causes of statistical differences.

Conclusions from the comparison
Due to scarce information in the ETS data, detailed comparisons of the ETS and NPD export data were difficult and not always meaningful. Detailed comparison of crude oil lifted by tanker showed a good agreement between the two data sources, and the two occurrences of mismatch could have natural causes, like time lag. The detailed comparison of isobutane shows a systematically lower amount in the ETS data, suggesting a positive statistical difference due to under-reporting or misclassification in the ETS. For the other products no conclusions can be drawn from the detailed comparison.

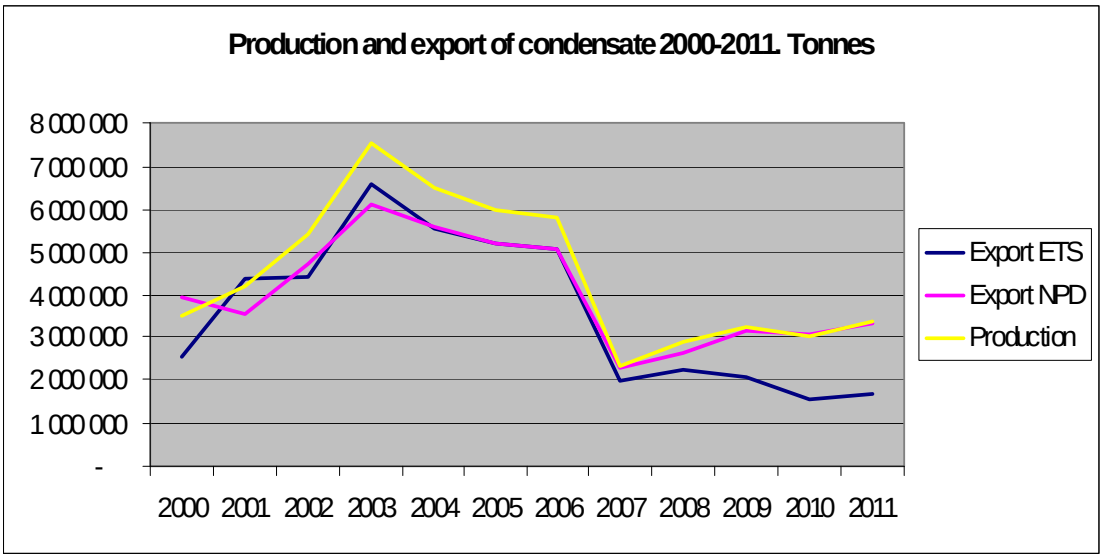
The aggregated comparisons show a consistent pattern where the NPD export exceeds the ETS export for all products investigated in this study, when crude oil transported by pipelines and ships are viewed together. We have not found any obvious reason for this, but the finding is worth noting as it corresponds to a positive statistical difference.

For most product streams detailed quality control of even short time spans required additional information which is not readily available. As a consequence, we doubt that detailed comparisons between export data from Statistics Norway and the NPD will work as a routine measure to reduce statistical difference in the energy balance.

7.4. A time series study of condensate

It has been an increasing difference between the figures from NPD for condensate production, and ETS figures for exports of condensate, and at the same time a growing difference between the NPD and Statistics Norway's figures for export of condensate (since 2007). The NPD figures for export and production are, on the other hand, approximately equal:

Figure 5: Time series study of different data sources to condensate



According to the NPD, most condensate is exported. Statistics Norway's figures for condensate are based on information from customs declarations, while the NPD figures are collected from the oil companies (operators). A reason for the lower figures in the ETS could be that some condensate is declared as crude oil or refined medium distillates instead of condensate (see figure 4).

For years after 2007, NPD is used as data source in the energy balance for export of condensate, and will continue to be so until the figures in the ETS has been improved or verified.

7.5. Measuring points

The location of measuring points and methodology for measuring is of great importance when it comes to ensuring the comparability of different data sources. We have discussed the location of measuring points with the NPD, without finding any major inconsistencies between the production and ETS export data. The inconsistency regarding unstabilized crude oil and rich gas landed in the UK, is already corrected for in the energy balance.

Transfers between different fuel types are another area where discrepancies can occur. This problem is relevant for several terminals and refineries. We will, as far as possible, examine possible losses/discrepancies in energy content for transfers and transformations by making energy balances separately for different energy goods (e.g. NGL fractions and condensate). This will also include an examination of measuring points for transfers and transformations. The results will be reported as far as the rules of confidentiality allow us.

7.6. Recommendations to reference approach

There are several potential sources of inconsistencies between the production data and the ETS export data on unrefined petroleum products, of which some may lead to errors in the ETS statistics. In order to improve the ETS statistics and it's consistency with the NPD production data in the energy balance, we recommend that a project is set down to evaluate the NPD export data as an alternative data source on unrefined petroleum products (excl. natural gas transported by the Gassled system).

If the NPD export data are going to be used as data source in the ETS, it should be considered to eliminate the inconsistency in classification between the NPD export and production data on condensate vs. NGL.

An improved ETS will also benefit the national account, as the statistical differences observed in the energy balance are also found as statistical differences in the national account.

The risk of errors due to misclassification by shipping agents will still not be completely eliminated, since there will still be an interface between the two data sources. This interface will then be between refined and unrefined petroleum products, and hence misclassification of refined products as unrefined or vice versa on the customs declarations will cause statistical differences (also on a total level).

Closer control with the classification done by the shipping agents and eventually training of shipping agents should be considered. It is not known to the project group how this control is performed today.

It must be born in mind that even though these errors are substantial compared to the national supply, they are small compared to total export.

8. Transparency

The ERT has recommended an increased transparency in the energy balance. This can be achieved through an increased disaggregation of fuels and by including transfer posts in the balance. When it comes to disaggregation of fuels, bio-diesel and bio-ethanol has been separated from auto-diesel and petrol in this year's submission of CRF, but are yet to be separated in the energy balances presented in the NIR. There is, however, a need for further disaggregation in order to increase transparency. It is, in particular, a need for splitting "Other gases" in the energy balance. Our aim is to perform the following split:

1) Refinery gas and fuel gas
2) Refinery – burning off of coke etc.
3) Blast furnace gas
4) Landfill gas and biogas

In addition we wish to separate waste from all wood products within biomass/other, and if possible split garbage of fossil origin from other types of waste.

The inclusion of transfer posts in the balance should also improve the transparency. This is because we have seen that certain products change name and product classification during its cycle from production to export or consumption.

The work on disaggregating fuels in the energy balance has been started. There are, however, confidentiality issues, as some fuels are only used by one, or a few, plants. The Statistical Act demands that no information which can be traced back to individual persons or companies is to be disclosed, and this makes it necessary to aggregate fuels. However, there are possibilities of presenting disaggregated tables, even though it may reveal information about individual entities, given that the information is of public interest and that the publication of information does not cause harm to the entity. In order to disclose such information, there must be an official decision from a confidentiality committee at Statistics Norway concerning each particular case.

The Division for energy and environmental statistics is in the process of presenting a case to the confidentiality committee concerning the dissemination of detailed energy balances. The rationale behind this case is that due to a low number entities within some energy demanding industries, and a low number of usages for some energy products, aggregation to a level in which no entities can

potentially be recognized leads to a lack of transparency, and in some cases an energy balance with little informational value.

Appendix A presents a suggestion of a disaggregated energy balance, with detailed splits on energy products and with transfer posts. Given a positive decision from the confidentiality committee, this is the level of disaggregation we wish to present during for the next annual submission in April 2014.

9. What is an acceptable level of statistical differences?

Statistics Norway maintains the position that a large statistical difference relative to national consumption is not unreasonable in Norway, given the large production and export share. This project has not revealed any major shortcomings of the consumption data of the energy balance, and it is likely that the main sources of statistical differences are to be found on the supply side of the equation. It is not feasible to set a fixed level of statistical difference that is considered acceptable. It could be determined as a percentage of production or consumption, but the actual level will depend on the production, export and consumption level, and the relationship between them, for each energy product. The level of statistical difference will continue to be evaluated, but it is unlikely that a strict rule can be determined.

10. Further work

According to the draft report of the individual review of the annual submission of Norway submitted in 2012, the ERT recommends that the Party extend the action plan beyond this time frame if the issues have not been resolved by the expected deadline. A lot of work has been performed during the past few months in response to the Saturday paper from the review team. However, the time frame between the in-country review and the submission of the CRF and NIR has not been long enough to finish all sub-projects. This has especially been the case for issues that involves contact with other divisions within the statistical office and other institutions, as this project came up with quite short notice, and the priorities of other units, both internally in Statistics Norway and in other institutions, are beyond our control. Thus, there are a few sub-projects that Statistics Norway, in collaboration with other institutions, will continue to work with towards the next annual submission in 2014.

Projects set down or in progress
1) Continued work with consistency. Although the energy balance as such is deemed to be a good data source for total energy consumption in Norway, there is a need for continued focus on improvements of consistency with other data sources and users. This is especially relevant in relation to the emission inventories and national accounts. There is an ongoing project on consolidation of the energy accounts and national accounts. The national accounts do not operate with statistical differences, and discrepancies between supply and consumption are allocated to stock changes. The consolidation project will focus on two demanding areas, namely the service industries and transport, in addition to general guidelines for choice of methodologies and data sources. No significant adjustments to totals are expected, but the project will further increase the cooperation between different divisions at Statistics Norway, including the Division for external trade statistics, which reduces the risk of errors.

The project is estimated to 6 labour months at the Division for energy and environmental statistics, plus resources used at other divisions. The project is part of the regular work with statistics production.

2) Improved production system for the energy balance. The energy balance is, as previously mentioned, produced in an Excel based system. This system has its shortcomings when it comes to agility and possibilities for including new variables and extracting information in a consistent manner. There is an ongoing project of restructuring the production system for the energy balance, possibly into a SAS environment. It is not a goal of this production alteration to reduce the statistical

differences as such, but the result will be a more robust system and increased transparency, and the process of getting there will be a quality control in itself.

The project is estimated to 6.8 labour months at the Division for energy and environmental statistics, plus resources used at other divisions. The project is part of the regular work with statistics production.

3) Efforts to improve the quality in statistics for deliveries of petroleum products have been implemented, and will be part of the routine statistics production. Detailed information from the oil companies customer record, will give us better understanding regarding the end-user of petroleum products, and hence reduced risk of errors. No significant amount of extra resources is expected to be needed.

4) The work with presenting more detailed energy balances has unfortunately not been completed. The case for the confidentiality committee has been prepared, but has not been considered yet. We are thus unfortunately not able to present more detailed energy balances at this point. What happens next for this issue depends on the outcome of the confidentiality discussion, but Statistics Norway will continue to improve the transparency of the energy balances as far as possible, given the resulting confidentiality limitations.

The project is estimated to 1 labour months at the Division for energy and environmental statistics, plus resources used at other divisions. The project is part of the regular work with statistics production.

New projects
1) Continued focus on export figures, and evaluating a new data source. During this project we have found some errors in the export figures from the external trade statistics (ETS) used in the energy balance, but there is need for additional focus here. However, given the nature of data sources in the ETS, we doubt that detailed comparisons between export data from Statistics Norway and the Norwegian Petroleum Directorate (NPD) will work as a routine measure to reduce statistical difference in the energy balance. Hence, in order to further reduce statistical differences in the energy balance we recommend a project to be set down to evaluate the NPD export data as an alternative to the existing data sources on unrefined petroleum products (excl. natural gas transported by the Gassled system) in the ETS export. The Division for environmental statistics will take initiative to this project, and foresee the following benefits from the change:

- Consistent production and export data, eliminating an important source to statistical differences.
- Detailed information for all shipments, allowing detailed quality control.
- Automatically update for new fields and pipelines.
- Consistent measuring point, eliminating the need for special estimations (“fractionations”) in the energy balance.
- Data from the Directorate of Customs and Excise with additional information from shipping agents can serve as data basis for non-routine detailed spot checks.

If successful, this project could mean a significant reduction in statistical difference in future reference years of the energy balance.

As misclassification between crude and refined petroleum products will still be a source of error, focus on the classifying made by shipping agents should still have focus. Furthermore, the project should evaluate if Norway appears as ‘transit country’ for petroleum produced on the Norwegian continental shelf. In such cases the NPD export would be underestimated. The work done so far in this project indicates that this is not the case.

The project will be quite comprehensive, but the Division for energy and environmental statistics will constitute only a minor part of it. The project, if run, will be finished in 2014 at earliest.

2) In addition, some minor tasks have not been prioritized within the limited time frame of this project. They are not expected to identify major causes of statistical differences, but will be performed in due time because they are part of the information sources available to us. These include:

a) Examination of the effect of conversion factors, especially with respect to crude oil.
b) Check of the energy statistics against energy information within the ETS system for the combustion in the energy sectors
c) Using payments of CO_2 tax as a check for offshore energy use.

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Appendix A: suggested disaggregation in the energy balance

Energy sources and sinks
1.1.1 Production of primary energy bearers
1.1.2 Production of natural gas that is flared off
2. Imports
3. Exports
4.1 Bunkering
4.2 Foreign aviation
5. Changes in stocks (+ net decrease, - net increase)
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)
X. Transfers
8. Energy converted
8.1. In blast furnaces
8.2. In crude petroleum refineries
8.3. In thermal power plants
8.4. In dual purpose power plants
8.5. In district heating plants
8.6. In hydropower plants
1.2. Production of derived energy bearers
9. Consumption by energy sector
9.1.1 Crude petroleum and natural gas production
9.1.2 Natural gas which is flared off on oil fields
9.2. Coal mines
9.3. Petroleum refineries
9.4. Pumping storage power plants
9.5. Hydro electric power plants
9.6. Thermal power plants
9.7. Combined heat and power plants
9.8. District heating plants
9.9. Gas supply
10. Losses in transport and distribution
11. Statistical differences (7-8+1.2-9-10-13.1)
13.1 Net domestic consumption, incl. non-energy use
13. Net domestic consumption
14. Manufacturing, mining and quarrying
14.1. Mining and quarrying
14.2. Manufacture of paper and paper products
14.3. Manufacture of industrial chemicals
14.4. Manufacture of iron, steel and ferro alloys
14.5. Manufacture of aluminium and other non-ferrous metals
14.6. Other manufacturing industries
15. Transport
15.1. Railways and subways
15.2. Air transport
15.3. Road transport
15.4. Coastal shipping
16. Other sectors
16.1. Fishing
16.2. Agriculture
16.3. Households
16.4. Other consumers
16.5 Construction
12. Consumption for non-energy purposes
12.1 Manufacture of industrial chemicals
12.2 Other manufacturing

Energy carriers
Anthracite
Other bituminous coal
Coke
Blast furnace gas
Petrol coke
Crude oil
Natural gas liquids (NGL)
Petrol
Naphta
Condensate
Kerosene
Middle distillates
Heavy fuel oil
LPG
Refinery gas and fuel gas
Refinery - burning off of coke etc
Lubricants
Bitumen
Natural gas
Landfill gas and biogas
Biodiesel
Bioethanol
Fuel wood and black liquor
Waste - biomass
Waste - other
Waterfall energy and wind power
Electricity
District heating

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Climate and Pollution Agency

The Climate and Pollution Agency reports to the Ministry of the Environment and has 325 employees, based mainly in Oslo. We implement government policy on pollution. We act as advisors, guardians and stewards for the environment. Our most important fields of work include climate change, chemicals, marine and freshwater environment, waste management, air quality and noise. Our vision is a future without pollution.
We are working to

- reduce greenhouse gas emissions
- reduce the spread of hazardous substances harmful to health and the environment
- achieve integrated and ecosystem-based management of the marine and freshwater environment
- increase waste recovery and reduce emissions from waste
- reduce the harmful effects of air pollution and noise

TA-3031 /2013