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Executive institution

The Norwegian Environment Agency

Project manager for the contractor

N.A.

Contact person in the Norwegian Environment Agency

Nina Holmengen

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Summary - sammendrag

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National Inventory Report 2015 – Norway

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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.

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 2013	Trend assessment Tier 1
2A1	Cement Production	CO_2	**1.22**	**1.36**	**0.32**
1A	A Stationary Fuel	CO_2	**1.64**	**1.26**	**0.87**
2B1	Ammonia Production	CO_2	**0.96**	**0.57**	**0.89**
2B6	Titanium dioxide	CO_2	**0.39**	**0.53**	**0.32**
1A5b	Mobile	CO_2	**0.77**	**0.46**	**0.69**
3B1	Cattle	CH_4	**0.50**	**0.44**	0.15
2A2	Lime Production	CO_2	0.10	**0.41**	**0.72**
3G	Liming	CO_2	**0.44**	0.13	**0.72**
2D1	Lubricant use	CO_2	0.32	0.11	**0.48**
2C4	Magnesium	SF_6	**3.93**	.	.
Qualitative key categories					
	Carbon capture and	CO_2			

Bold figures indicate whether the source category is a key.

The analyses have been performed for 1990 and 2013 GHG emission data. The main conclusion is that there are few differences in the result for 1990 compared with 2013.

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 GPG (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 2013	Trend assessment Tier 2 1990-2013	Method (Tier) 2013
Tier 2 key categories (large contribution to the total inventory uncertainty)						
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous Fuels	CO_2	**4.39**	**8.95**	**10.95**	Tier 2
3Da1	Synthetic Fertilizers	N_2O	**10.44**	**8.78**	**3.63**	Tier 1
3Da5	Cultivation of Histosols	N_2O	**7.74**	**7.52**	0.22	Tier 1
3A	Enteric Fermentation	CH_4	**7.16**	**5.91**	**2.66**	Tier1/2*
1A3b	Road Transportation	CO_2	**4.46**	**5.58**	**2.82**	Tier 1a
2F	Product uses as substitutes for ODS	HFCs	0.00	**5.51**	**13.01**	Tier 2
1B2a	Oil (incl. oil refineries, gasoline distribution)	CO_2	**4.18**	**4.45**	**0.80**	Tier 2
5A1	Managed Waste Disposal sites	CH_4	**7.45**	**4.12**	**7.56**	Tier 2
3Da2	Organic N fertilizer	N_2O	**3.51**	**3.66**	0.16	Tier 1
3Db1	Atmospheric Deposition	N_2O	**3.18**	**3.62**	**1.17**	Tier 1
1A3d	Navigation	CO_2	**3.44**	**3.35**	0.08	Tier 2
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Other Fuels	CO_2	**0.97**	**3.33**	**5.60**	Tier 2
3Da3	Animal production	N_2O	**3.89**	**3.16**	**1.59**	Tier 2
1B2c	Venting and Flaring	CH_4	**1.38**	**3.00**	**3.89**	Tier 2
1A4	Other sectors - Mobile Fuel Combustion	CO_2	**2.21**	**2.57**	**0.93**	Tier 2
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Liquid Fuels	CO_2	**2.94**	**2.39**	**1.17**	Tier 2
1A3a	Civil Aviation	CO_2	**1.38**	**2.38**	**2.42**	Tier 2
2C3	Aluminium production	CO_2	**1.48**	**1.80**	**0.81**	Tier 2
3Db2	Nitrogen Leaching and Run-off	N_2O	**2.09**	**1.80**	0.59	Tier 1
1B2c	Venting and Flaring	CO_2	**1.85**	**1.53**	**0.68**	Tier 2
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Biomass	CH_4	**1.25**	**1.34**	0.26	Tier 1
3Da4	Crop Residue	N_2O	**2.13**	**1.16**	**2.20**	Tier 1
1B2a	Oil (incl. oil refineries, gasoline distribution)	CH_4	**0.93**	**1.15**	0.55	Tier 2
5D	Wastewater treatment and discharge	N_2O	**0.86**	**1.02**	0.41	Tier 1
1A3d	Navigation	CH_4	0.04	**0.94**	**2.12**	Tier 2
1B1a	Coal Mining	CH_4	**1.18**	**0.73**	**1.01**	Tier 1
2C2	Ferroalloys production	CO_2	0.77	**0.68**	0.18	Tier 2
5D	Wastewater treatment and discharge	CH_4	**1.21**	0.66	**1.26**	Tier 1
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous Fuels	CH_4	0.35	0.60	**0.60**	Tier 2
1B2b	Natural Gas	CH_4	0.02	0.36	**0.81**	Tier 2
2C3	Aluminium production	PFCs	**7.89**	0.35	**17.49**	Tier 2
5B	Biological treatment of Solid Waste	CH_4	0.03	0.35	**0.75**	Tier 1
5B	Biological treatment of Solid Waste	N_2O	0.03	0.29	**0.63**	Tier 1
2B2	Nitric Acid Production	N_2O	**1.20**	0.15	**2.42**	Tier 2
1A3b	Road Transportation	CH_4	0.39	0.07	**0.73**	Tier 3
2B5	Carbide production	CO_2	0.42	0.05	**0.86**	Tier 2

Tier 1 key categories (large contribution to the total emissions)						
1A	Stationary Fuel Combustion (1A1-1A2-1A4), Solid Fuels	CO_2	0.74	0.56	0.39	Tier 2
3B1	Cattle	CH_4	0.54	0.46	0.16	Tier 2
2B6	Titanium dioxide production	CO_2	0.21	0.28	0.18	Tier 2
1A5b	Mobile	CO_2	0.45	0.27	0.41	Tier 2
2B1	Ammonia Production	CO_2	0.38	0.22	0.36	Tier 2
2D1	Lubricant use	CO_2	0.33	0.11	0.51	Tier 1
3G	Liming	CO_2	0.26	0.07	0.43	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	Magnesium production	SF_6	0.05	.	.	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 1990	Level assessment 2013	Trend assessment 1990-2013	Method (Tier) 2013
Tier 2 key categories (large contribution to the total inventory uncertainty)						
4.A.1	Forest remaining forest - Living biomass	CO_2	**10.83**	**17.82**	**20.71**	Tier 3
4.A.1	Forest remaining forest - Litter + dead wood + Mineral soil	CO_2	**2.97**	**5.52**	**6.70**	Tier 3
4.E.2.1	Forest to Settlement - DOM	CO_2	0.29	**4.82**	**7.57**	Tier 2
4.B.1	Cropland remaining cropland - Organic soil	CO_2	**3.46**	**2.33**	**1.18**	Tier 1
4.A.1	Forest remaining forest, drained organic soils - Organic soil	CO_2	**2.85**	**2.07**	**1.21**	Tier 1
4.E.2.1	Forest to Settlement - Living biomass	CO_2	**1.73**	**1.90**	**1.78**	Tier 3
4.C.2.1	Forest to Grassland - DOM	CO_2	0.01	**1.57**	**2.52**	Tier 2
4.A.2.4	Settlement to Forest - Litter + DOM	CO_2	0.05	**1.09**	**1.73**	Tier 2
4.G	Harwested Wood Products - HWP	CO_2	**3.51**	**0.98**	**4.21**	Tier 2
4.B.2.1	Forest to Cropland - DOM	CO_2	0.03	**0.94**	**1.49**	Tier 2
4(II)	Forest rem forest - Organic soil	N_2O	**1.20**	**0.90**	**0.56**	Tier 1
4.E.2.1	Forest to Settlement - Mineral soil	CO_2	0.05	**0.83**	**1.31**	Tier 2
4.C.2.1	Forest to Grassland - Living biomass	CO_2	0.24	**0.69**	**0.94**	Tier 3
4.E.2.1	Forest to Settlement - Organic soil	CO_2	.	**0.63**	.	Tier 1
4.E.1	Settlements remaining settlements - Organic soil	CO_2	**0.86**	**0.57**	0.28	Tier 1

4.C.2.1	Forest to Grassland - Mineral soil	CO_2	0.01	**0.56**	**0.90**	Tier 2
4.B.2.3	Wetland to Cropland - Organic soil	CO_2	.	**0.50**	.	Tier 1
4.B.2.1	Forest to Cropland - Living biomass	CO_2	0.48	**0.46**	**0.39**	Tier 3
4(II)	Forest rem forest - Organic soil	CH_4	**0.58**	**0.43**	0.26	Tier 1
4(III)	Direct N_2O from N mineralization/immobilization - N_2O	N_2O	0.02	**0.40**	**0.63**	Tier 1
4.C.1	Grassland remaining grassland - Living biomass	CO_2	.	**0.38**	.	Tier 3
4.B.2.1	Forest to Cropland - Mineral soil	CO_2	0.01	**0.37**	**0.59**	Tier 2
4.A.2.2	Grassland to Forest - Mineral soil	CO_2	0.02	**0.36**	**0.57**	Tier 2
4.B.2.1	Forest to Cropland - Organic soil	CO_2	0.03	0.33	**0.51**	Tier 1
4.C.1	Grassland remaining grassland - Organic soil	CO_2	**1.05**	0.28	0.33	Tier 1
4.E.2.2	Cropland to Settlement - Mineral soil	CO_2	0.02	0.26	**0.41**	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 2013	Trend assessment Tier 1 1990-2013
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous Fuels	CO_2	**10.44**	**21.66**	**25.60**
1A3b	Road Transportation	CO_2	**14.67**	**18.67**	**9.12**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Liquid Fuels	CO_2	**13.27**	**10.99**	**5.22**
1A4	4 Other sectors - Mobile Fuel Combustion	CO_2	**4.07**	**4.80**	**1.67**
3A	Enteric Fermentation	CH_4	**5.38**	**4.52**	**1.97**
2C2	Ferroalloys production	CO_2	**4.91**	**4.42**	**1.11**
2C3	Aluminium production	CO_2	**2.73**	**3.37**	**1.46**
1A3d	Navigation	CO_2	**3.26**	**3.23**	0.07
1B2c	Venting and Flaring	CO_2	**3.30**	**2.77**	**1.19**
1A3a	Civil Aviation	CO_2	**1.31**	**2.29**	**2.26**
5A1	Managed Waste Disposal sites	CH_4	**3.96**	**2.23**	**3.95**
1B2a	Oil (incl. oil refineries, gasoline distribution)	CO_2	**2.00**	**2.17**	**0.38**
2F	Product uses as substitutes for ODS	HFCs	0.00	**2.15**	**4.91**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Other Fuels	CO_2	**0.61**	**2.14**	**3.47**
2A1	Cement Production	CO_2	**1.22**	**1.36**	**0.32**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Solid Fuels	CO_2	**1.64**	**1.26**	**0.87**

3Da1	Synthetic Fertilizers	N_2O	**0.98**	**0.83**	**0.34**
1B2c	Venting and Flaring	CH_4	**0.37**	**0.81**	**1.02**
3Da5	Cultivation of Histosols	N_2O	**0.73**	**0.73**	0.02
2B1	Ammonia Production	CO_2	**0.96**	**0.57**	**0.89**
1B2a	Oil (incl. oil refineries, gasoline distribution)	CH_4	**0.44**	**0.56**	0.26
2B6	Titanium dioxide production	CO_2	**0.39**	**0.53**	**0.32**
2B2	Nitric Acid Production	N_2O	**3.83**	**0.49**	**7.63**
3Da2	Organic N fertilizer	N_2O	**0.47**	**0.48**	0.03
1A5b	Mobile	CO_2	**0.77**	**0.46**	**0.69**
3B1	Cattle	CH_4	**0.50**	**0.44**	0.15
2A2	Lime Production	CO_2	0.10	**0.41**	**0.72**
2C3	Aluminium production	PFCs	**7.49**	**0.34**	**16.31**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Biomass	CH_4	0.31	**0.33**	0.06
3Da3	Animal production	N_2O	**0.37**	0.31	0.15
1A3d	Navigation	CH_4	0.01	0.24	**0.54**
3G	Liming	CO_2	**0.44**	0.13	**0.72**
2D1	Lubricant use	CO_2	0.32	0.11	**0.48**
2B5	5 Other Chemical Industry	CO_2	**0.77**	0.09	**1.55**
1A3b	Road Transportation	CH_4	0.16	0.03	**0.30**
2C4	Magnesium production	SF_6	**3.93**	.	.

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 2013**	**Trend assessment Tier 2 1990-2013**
4.A.1	Forest remaining forest - Living biomass	CO_2	**10.83**	**17.82**	**20.71**
4.A.1	Forest remaining forest - Litter + dead wood + Mineral soil	CO_2	**2.97**	**5.52**	**6.70**
4.E.2.1	Forest to Settlement - DOM	CO_2	0.29	**4.82**	**7.57**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous Fuels	CO_2	**2.95**	**4.36**	**4.84**
3Da1	Synthetic Fertilizers	N_2O	**7.03**	**4.28**	**1.57**
3Da5	Cultivation of Histosols	N_2O	**5.21**	**3.66**	**2.03**
3A	Enteric Fermentation	CH_4	**4.82**	**2.88**	**1.05**
1A3b	Road Transportation	CO_2	**3.00**	**2.72**	**2.15**
2F	Product uses as substitutes for ODS	HFCs	0.00	**2.68**	**4.34**
4.B.1	Cropland remaining cropland - Organic soil	CO_2	**3.46**	**2.33**	**1.18**
1B2a	Oil (incl. oil refineries, gasoline distribution)	CO_2	**2.82**	**2.17**	**1.40**
4.A.1	Forest remaining forest, drained organic soils - Organic soil	CO_2	**2.85**	**2.07**	**1.21**
5A1	Managed Waste Disposal sites	CH_4	**5.02**	**2.01**	**0.50**
4.E.2.1	Forest to Settlement - Living biomass	CO_2	**1.73**	**1.90**	**1.78**
3Da2	Organic N fertilizer	N_2O	**2.36**	**1.77**	**0.71**
3Db1	Atmospheric Deposition	N_2O	**2.14**	**1.76**	**1.25**

1A3d	Navigation	CO_2	**2.31**	**1.63**	**0.91**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Other Fuels	CO_2	**0.66**	**1.62**	**2.13**
4.C.2.1	Forest to Grassland - DOM	CO_2	0.01	**1.57**	**2.52**
3Da3	Animal production	N_2O	**2.62**	**1.54**	**0.53**
1B2c	Venting and Flaring	CH_4	**0.93**	**1.46**	**1.67**
1A4	4 Other sectors - Mobile Fuel Combustion	CO_2	**1.49**	**1.25**	**0.91**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Liquid Fuels	CO_2	**1.98**	**1.16**	**0.40**
1A3a	Civil Aviation	CO_2	**0.93**	**1.16**	**1.18**
4.A.2.4	Settlement to Forest - Litter + DOM	CO_2	0.05	**1.09**	**1.73**
4.G	Harwested Wood Products - HWP	CO_2	**3.51**	**0.98**	**4.21**
4.B.2.1	Forest to Cropland - DOM	CO_2	0.03	**0.94**	**1.49**
4(II)	Forest rem forest - Organic soil	N_2O	**1.20**	**0.90**	**0.56**
2C3	Aluminium production	CO_2	**1.00**	**0.88**	**0.67**
3Db2	Nitrogen Leaching and Run-off	N_2O	**1.40**	**0.88**	0.37
4.E.2.1	Forest to Settlement - Mineral soil	CO_2	0.05	**0.83**	**1.31**
1B2c	Venting and Flaring	CO_2	**1.25**	**0.75**	0.28
4.C.2.1	Forest to Grassland - Living biomass	CO_2	0.24	**0.69**	**0.94**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Biomass	CH_4	**0.84**	**0.65**	**0.42**
4.E.2.1	Forest to Settlement - Organic soil	CO_2	.	**0.63**	.
4.E.1	Settlements remaining settlements - Organic soil	CO_2	**0.86**	**0.57**	0.28
3Da4	Crop Residue	N_2O	**1.43**	**0.57**	0.16
4.C.2.1	Forest to Grassland - Mineral soil	CO_2	0.01	**0.56**	**0.90**
1B2a	Oil (incl. oil refineries, gasoline distribution)	CH_4	**0.63**	**0.56**	**0.44**
5D	Wastewater treatment and discharge	N2O	**0.58**	**0.50**	**0.37**
4.B.2.3	Wetland to Cropland - Organic soil	CO_2	.	**0.50**	.
4.B.2.1	Forest to Cropland - Living biomass	CO_2	0.48	**0.46**	**0.39**
1A3d	Navigation	CH_4	0.03	**0.46**	**0.72**
4(II)	Forest rem forest - Organic soil	CH_4	**0.58**	**0.43**	0.26
4(III)	Direct N2O from N mineralization/immobilization - N_2O	N_2O	0.02	**0.40**	**0.63**
4.C.1	Grassland remaining grassland - Living biomass	CO_2	.	**0.38**	.
4.B.2.1	Forest to Cropland - Mineral soil	CO_2	0.01	**0.37**	**0.59**
4.A.2.2	Grassland to Forest - Mineral soil	CO_2	0.02	**0.36**	**0.57**
1B1a	Coal Mining	CH_4	**0.79**	**0.36**	0.02
2C2	Ferroalloys production	CO_2	0.52	**0.33**	0.15
4.B.2.1	Forest to Cropland - Organic soil	CO_2	0.03	0.33	**0.51**
5D	Wastewater treatment and discharge	CH_4	**0.82**	0.32	0.09
4.C.1	Grassland remaining grassland - Organic soil	CO_2	**1.05**	0.28	0.33
4.E.2.2	Cropland to Settlement - Mineral soil	CO_2	0.02	0.26	**0.41**
2C3	Aluminium production	PFCs	**5.31**	0.17	**3.69**
2B2	Nitric Acid Production	N_2O	**0.81**	0.07	**0.48**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Solid Fuels	CO_2	0.50	0.27	0.07
3B1	Cattle	CH_4	0.36	0.22	0.09
2B6	Titanium dioxide production	CO_2	0.14	0.14	0.12
1A5b	Mobile	CO_2	0.30	0.13	0.02
2B1	Ammonia Production	CO_2	0.26	0.11	0.02

3G	Liming	CO_2	0.17	0.04	0.07
2A1	Cement Production	CO_2	0.03	0.02	0.02
2B5	Other Chemical Industry	CO_2	0.28	0.02	0.17
2A2	Lime Production	CO_2	0.00	0.01	0.01
2C4	Magnesium production	SF_6	0.03	.	.

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 2013	Trend assessment Tier 2 1990-2013
4.A.1	Forest remaining forest - Living biomass	CO_2	**15.28**	**27.40**	**32.14**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous Fuels	CO_2	**7.75**	**12.48**	**13.97**
1A3b	Road Transportation	CO_2	**10.89**	**10.75**	**8.58**
4.A.1	Forest remaining forest - Litter + dead wood + Mineral soil	CO_2	**3.31**	**6.70**	**8.21**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Liquid Fuels	CO_2	**9.86**	**6.33**	**2.22**
1A4	4 Other sectors - Mobile Fuel Combustion	CO_2	**3.02**	**2.77**	**2.03**
3A	Enteric Fermentation	CH_4	**4.00**	**2.60**	**0.96**
2C2	Ferroalloys production	CO_2	**3.65**	**2.55**	**1.16**
2C3	Aluminium production	CO_2	**2.03**	**1.94**	**1.50**
1A3d	Navigation	CO_2	**2.42**	**1.86**	**1.04**
4.B.1	Cropland remaining cropland - Organic soil	CO_2	**2.29**	**1.68**	**0.86**
1B2c	Venting and Flaring	CO_2	**2.45**	**1.60**	**0.59**
1A3a	Civil Aviation	CO_2	**0.97**	**1.32**	**1.36**
5A1	Managed Waste Disposal sites	CH_4	**2.94**	**1.29**	**0.32**
1B2a	Oil (incl. oil refineries, gasoline distribution)	CO_2	**1.49**	**1.25**	**0.81**
2F	Product uses as substitutes for ODS	HFCs	0.00	**1.24**	**2.02**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Other Fuels	CO_2	**0.46**	**1.23**	**1.63**
4.E.2.1	Forest to Settlement - DOM	CO_2	0.06	**1.09**	**1.73**
2A1	Cement Production	CO_2	**0.91**	**0.78**	**0.53**
4.A.1	Forest remaining forest, drained organic soils - Organic soil	CO_2	**0.94**	**0.75**	**0.44**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Solid Fuels	CO_2	**1.22**	**0.73**	0.18
4.E.2.1	Forest to Settlement - Living biomass	CO_2	**0.59**	**0.71**	**0.67**
3Da1	Synthetic Fertilizers	N_2O	**0.74**	**0.49**	0.18
1B2c	Venting and Flaring	CH_4	0.27	**0.47**	**0.54**
4.G	Harwested Wood Products - HWP	CO_2	**1.43**	**0.44**	**1.88**
3Da5	Cultivation of Histosols	N_2O	**0.55**	**0.42**	**0.23**
3Da2	Organic N fertilizer	N_2O	**0.49**	**0.40**	0.16
2B1	Ammonia Production	CO_2	**0.71**	**0.33**	0.05
4(II)	Forest rem forest - Organic soil	N_2O	**0.40**	**0.32**	**0.20**

1B2a	Oil (incl. oil refineries, gasoline distribution)	CH_4	**0.33**	**0.32**	**0.25**
4.C.2.1	Forest to Grassland - DOM	CO_2	0.00	**0.31**	**0.51**
2B6	Titanium dioxide production	CO_2	**0.29**	**0.30**	**0.26**
2B2	Nitric Acid Production	N_2O	**2.85**	**0.28**	**1.88**
1A5b	Mobile	CO_2	**0.57**	**0.27**	0.03
3B1	Cattle	CH_4	**0.37**	**0.25**	0.10
2A2	Lime Production	CO_2	0.07	**0.24**	**0.33**
4.A.2.4	Settlement to Forest - Litter + DOM	CO_2	0.01	**0.23**	**0.37**
4.E.2.1	Forest to Settlement - Organic soil	CO_2	.	**0.20**	.
4.E.1	Settlements remaining settlements - Organic soil	CO_2	**0.28**	**0.20**	0.10
4.C.2.1	Forest to Grassland - Mineral soil	CO_2	0.00	**0.20**	**0.32**
2C3	Aluminium production	PFCs	**5.56**	**0.20**	**4.25**
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Biomass	CH_4	0.23	**0.19**	0.13
4.E.2.1	Forest to Settlement - Mineral soil	CO_2	0.01	0.19	**0.30**
3Da3	Animal production	N_2O	**0.28**	0.18	0.06
4.B.2.1	Forest to Cropland - DOM	CO_2	0.01	0.16	**0.25**
4.C.2.1	Forest to Grassland - Living biomass	CO_2	0.04	0.14	**0.20**
1A3d	Navigation	CH_4	0.01	0.14	**0.22**
3G	Liming	CO_2	**0.33**	0.07	0.15
2B5	5 Other Chemical Industry	CO_2	**0.57**	0.05	**0.39**
2C4	Magnesium production	SF_6	**2.92**	.	.

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-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	2013	1990	2013	1990	2013		CO_2	CH_4	N_2O
1A	A Stationary Fuel Combustion (1A1-1A2-1A4), Biomass	.	.	159.59	179.56	37.63	45.65	30	.	72	1
	A Stationary Fuel Combustion (1A1-1A2-1A4), Gaseous Fuels	5431.47	11637.22	48.87	87.66	2.75	6.02	4	7	72	1
	A Stationary Fuel Combustion (1A1-1A2-1A4), Liquid Fuels	6905.10	5901.78	11.88	6.36	21.73	21.92	3	3	72	1
	A Stationary Fuel Combustion (1A1-1A2-1A4), Other Fuels	319.75	1147.04	4.68	17.71	7.44	18.74	5	30	72	1
	A Stationary Fuel Combustion (1A1-1A2-1A4), Solid Fuels	853.95	678.05	3.21	0.44	3.34	2.41	5	7	72	1
1A3a	Civil Aviation	679.38	1232.73	0.44	0.90	6.43	11.66	20	3	72	1
1A3b	Road Transportation	7630.18	10027.60	85.06	16.41	55.43	66.87	5	3	45	65
1A3c	Railways	96.40	47.13	0.14	0.07	10.84	5.28	5	3	72	1
1A3d	Navigation	1696.41	1735.07	5.32	131.53	10.63	10.48	20	3	72	1
1A4	4 Other sectors - Mobile Fuel Combustion	2117.04	2580.27	11.62	14.58	17.49	23.78	10	3	72	1
1A5a	Stationary	62.45	21.50	0.21	0.12	0.15	0.27	3	5	72	1
1A5b	Mobile	399.87	249.78	0.42	3.16	3.61	2.11	5	10	72	1
1B1a	Coal Mining	20.43	13.60	163.42	106.25	.	.	3	72	72	.
1B2a	Oil (incl. oil refineries, gasoline distribution)	1041.09	1164.08	231.02	299.38	.	.	3	40	40	.
1B2b	Natural Gas	3.10	11.70	3.00	52.85	.	.	3	72	72	.
1B2c	Venting and Flaring	1714.53	1490.43	190.92	436.88	4.98	3.26	4	10	72	1
2A1	Cement Production	634.26	730.64	.	.	.	.	0.444398	0.566764	.	.
2A2	Lime Production	49.85	220.68	.	.	.	.	0.364965	0.482322	.	.
2A3	Glass production	5.58	5.32	.	.	.	.	0.1	5	.	.
2A4	Other process uses of carbonates	34.72	93.00	.	.	.	.	0.1	5	.	.
2B1	Ammonia Production	500.12	306.81	.	.	.	.	3	7	.	.
2B10	Other	.	.	.	.	57.96	127.54	26	.	.	0

2B2	Nitric Acid Production	.	.	.	.	1993.32	261.52	0	.	.	5.987344
2B5	5 Other Chemical Industry	399.59	47.14	8.76	1.78	.	.	3	10	10	.
2B6	Titanium dioxide production	201.10	283.42	.	.	.	.	3	10	.	.
2B8	Petrochemical and carbon black production	87.70	115.81	1.93	16.20	0.02	0.42	9	0.74173	72	0
2C1a	Steel	12.35	26.72	.	.	.	.	1.23	1.2983	.	.
2C2	Ferroalloys production	2553.70	2374.94	1.24	1.28	5.02	4.06	0	3	72	10
2C3	Aluminium production	1419.00	1809.39	.	.	.	.	3	10	.	.
2C4	Magnesium production	127.65	.	.	.	.	.	0	5	.	.
2C6	Zinc production	2.96	5.22	.	.	.	.	5	5	.	.
2C7	Other	49.78	94.23	.	.	.	.	10	10	.	.
2D1	Lubricant use	167.07	60.21	.	.	.	.	0	20	.	.
2D2	Paraffin wax use	6.23	51.28	.	.	.	.	30	10	.	.
2D3	Other	114.15	107.91	.	.	.	.	0	10	.	.
2G3	N2O from product uses	.	.	.	.	34.16	30.10	0	.	.	15
2H1	Pulp and Paper	10.43	9.86	.	.	.	.	0.915625	10	.	.
2H2	Food and beverages industry	20.79	91.25	.	.	.	.	10	10	.	.
3A	Enteric Fermentation	.	.	2801.48	2429.03	.	.	5	.	25	.
3B	Manure Management	.	.	.	.	76.18	71.83	24	.	.	72
3B1	Cattle	.	.	260.73	233.99	.	.	5	.	20	.
3B2	Sheep	.	.	7.35	7.13	.	.	5	.	30	.
3B3	Swine	.	.	48.72	59.43	.	.	5	.	20	.
3B4	Other	.	.	14.12	21.35	.	.	5	.	30	.
3Da1	Synthetic Fertilizers	.	.	.	.	511.06	447.24	5	.	.	200
3Da2	Organic N fertilizer	.	.	.	.	242.98	257.65	22	.	.	1
3Da3	Animal production	.	.	.	.	193.11	164.43	22	.	.	200
3Da4	Crop Residue	.	.	.	.	104.97	60.11	30	.	.	200
3Da5	Cultivation of Histosols	.	.	.	.	382.00	389.61	30	.	.	200
3Db1	Atmospheric Deposition	.	.	.	.	79.07	94.55	30	.	.	400
3Db2	Nitrogen Leaching and Run-off	.	.	.	.	170.46	154.49	70	.	.	1
3F1	Cereals	.	.	27.15	2.20	8.39	0.68	10	.	72	1
3G	Liming	230.97	68.62	.	.	.	.	5	10	.	.
3H	Urea application	0.55	0.16	.	.	.	.	5	10	.	.

5A1	Managed Waste Disposal sites	.	.	2061.76	1198.82	.	.	20	.	30	.
5B	Biological treatment of Solid Waste	.	.	2.92	35.82	2.61	30.23	20	.	1	1
5C	Incinertion and open burning of waste	0.19	.	0.02	0.04	0.07	0.07	30	30	72	1
5D	Wastewater treatment and discharge	.	.	117.37	67.02	115.94	144.48	25	.	1	70

	Category - Fuel	HFCs Gg CO_2 eq.		PFCs Gg CO_2 eq.		SF_6 Gg CO_2 eq.		Uncertainty activity	Uncertainty emission factor 2σ, %		
		1990	2013	1990	2013	1990	2013	2σ, %	HFCs	PFCs	SF_6
2C3	Aluminium production	.	.	3894.80	182.04	.	.	3	.	20	.
2C4	Magnesium production	.	.	.	.	2045.16	.	0	.	.	0.25
2E1	By-product Emissions	.	.	.	.	.	1.14	0	.	.	300
2F	Product uses as substitutes for ODS	0.04	1155.09	.	0.02	.	.	0	50	50	.
2G1	Electrical equiptment	.	.	.	.	51.14	46.70	0	.	.	60
2G2	SF6 and PFCs from other product use	.	.	.	.	2.23	12.79	0	.	.	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	2013	1990	2013	1990	2013		CO_2	CH_4	N_2O
4(I)	Forest-Direct N_2O - Inorganic N	.	.	.	.	0.70	0.51	0	.	.	201
	Forest-Direct N_2O - Organic N	.	.	.	.	21.93	20.17	0	.	.	206
	Settlements-Direct N2O - Organic N	.	.	.	.	2.98	5.96	0	.	.	201
4(II)	Cropland - Organic soil	.	.	80.93	88.20	.	.	0	.	75	.
	Forest rem forest - Organic soil	.	.	47.73	51.60	276.84	301.87	0	.	180	64
	Grasland - Organic soil	.	.	13.18	6.33	.	.	0	.	119	.
	Peat extraction - Organic soil	.	.	0.33	0.33	0.04	0.04	0	.	95	124

4(III)	Direct N2O from N mineralization/immobilization - N_2O	.	.	.	.	1.39	38.66	0	.	.	224
4(IV)	Indirect N2O from Managed soils - AtmDep	.	.	.	.	0.51	0.54	0	.	.	475
	Indirect N2O from Managed soils - LeachRun	.	.	.	.	6.11	14.81	0	.	.	300
4(V)	Forest land - Biomass burning	.	.	1.33	0.07	0.11	0.01	0	.	75	75
4.A.1	Forest remaining forest - Litter + dead wood + Mineral soil	-2315.39	-6251.85	.	.	.	.	0	19	.	.
	Forest remaining forest - Living biomass	-10703.00	-25563.40	.	.	.	.	0	15	.	.
	Forest remaining forest, drained organic soils - Organic soil	661.17	695.27	.	.	.	.	0	64	.	.
4.A.2.1	Cropland to Forest - Litter + DOM	-4.36	-0.77	.	.	.	.	0	115	.	.
	Cropland to Forest - Living biomass	-29.66	-43.30	.	.	.	.	0	105	.	.
	Cropland to Forest - Mineral soil	1.83	40.26	.	.	.	.	0	79	.	.
	Cropland to Forest - Organic soil	0.51	6.16	.	.	.	.	0	132	.	.
4.A.2.2	Grassland to Forest - Litter + DOM	-5.68	-1.36	.	.	.	.	0	201	.	.
	Grassland to Forest - Living biomass	-1.80	-12.98	.	.	.	.	0	201	.	.
	Grassland to Forest - Mineral soil	3.78	110.92	.	.	.	.	0	70	.	.
	Grassland to Forest - Organic soil	.	8.29	.	.	.	.	0	148	.	.
4.A.2.3	Wetland to Forest - Litter + DOM	-1.92	-31.16	.	.	.	.	0	124	.	.
	Wetland to Forest - Living biomass	.	-6.01	.	.	.	.	0	106	.	.
	Wetland to Forest - Mineral soil	0.92	15.22	.	.	.	.	0	136	.	.
	Wetland to Forest - Organic soil	0.51	11.22	.	.	.	.	0	102	.	.
4.A.2.4	Settlement to Forest - Litter + DOM	-6.82	-215.89	.	.	.	.	0	109	.	.
	Settlement to Forest - Living biomass	-8.25	-41.25	.	.	.	.	0	65	.	.
	Settlement to Forest - Mineral soil	-1.25	-40.00	.	.	.	.	0	109	.	.
	Settlement to Forest - Organic soil	.	1.10	.	.	.	.	0	204	.	.
4.A.2.5	Other land to Forest - Litter + DOM	-0.16	-7.42	.	.	.	.	0	153	.	.
	Other land to Forest - Living biomass	-0.55	-7.22	.	.	.	.	0	133	.	.
	Other land to Forest - Mineral soil	-0.15	-6.42	.	.	.	.	0	153	.	.
4.B.1	Cropland remaining cropland - Living biomass	-15.76	-6.84	.	.	.	.	0	75	.	.
	Cropland remaining cropland - Mineral soil	-7.33	-53.46	.	.	.	.	0	50	.	.
	Cropland remaining cropland - Organic soil	1601.16	1565.78	.	.	.	.	0	32	.	.
4.B.2.1	Forest to Cropland - DOM	3.63	145.90	.	.	.	.	0	138	.	.
	Forest to Cropland - Living biomass	51.04	71.68	.	.	.	.	0	138	.	.

	Forest to Cropland - Mineral soil	-1.43	-57.49	.	.	.	.	0	139	.	.
	Forest to Cropland - Organic soil	4.80	66.59	.	.	.	.	0	107	.	.
4.B.2.2	Grassland to Cropland - Mineral soil	.	4.22	.	.	.	.	0	150	.	.
	Grassland to Cropland - Organic soil	3.74	14.92	.	.	.	.	0	201	.	.
4.B.2.3	Wetland to Cropland - Organic soil	.	107.03	.	.	.	.	0	100	.	.
4.B.2.4	Settlement to Cropland - Mineral soil	-0.40	-4.58	.	.	.	.	0	174	.	.
4.C.1	Grassland remaining grassland - Living biomass	.	-36.19	.	.	.	.	0	227	.	.
	Grassland remaining grassland - Mineral soil	-26.73	31.42	.	.	.	.	0	92	.	.
	Grassland remaining grassland - Organic soil	160.38	62.48	.	.	.	.	0	97	.	.
4.C.2.1	Forest to Grassland - DOM	1.91	293.55	.	.	.	.	0	115	.	.
	Forest to Grassland - Living biomass	31.46	132.77	.	.	.	.	0	112	.	.
	Forest to Grassland - Mineral soil	-1.17	-182.34	.	.	.	.	0	66	.	.
4.C.2.3	Wetland to Grassland - Living biomass	.	0.29	.	.	.	.	0	201	.	.
	Wetland to Grassland - Organic soil	.	14.52	.	.	.	.	0	201	.	.
4.D.1.1	Wetland Peat extraction - on+off-site - Organic soil	64.64	60.21	.	.	.	.	0	98	.	.
4.D.1.3	Wetlands remaining wetlands, wooded mires - Living biomass	-71.50	-66.44	.	.	.	.	0	21	.	.
4.D.2.3	Forest to Wetland - DOM	.	20.39	.	.	.	.	0	217	.	.
	Forest to Wetland - Living biomass	.	28.56	.	.	.	.	0	201	.	.
	Forest to Wetland - Organic soil	.	1.65	.	.	.	.	0	148	.	.
4.D.2.3.1	Forest to Wetland - Mineral soil	.	-9.28	.	.	.	.	0	217	.	.
4.E.1	Settlements remaining settlements - Organic soil	193.20	186.23	.	.	.	.	0	66	.	.
4.E.2.1	Forest to Settlement - DOM	42.61	1017.17	.	.	.	.	0	102	.	.
	Forest to Settlement - Living biomass	413.71	659.45	.	.	.	.	0	62	.	.
	Forest to Settlement - Mineral soil	7.37	175.71	.	.	.	.	0	102	.	.
	Forest to Settlement - Organic soil	.	186.41	.	.	.	.	0	73	.	.
4.E.2.2	Cropland to Settlement - Mineral soil	2.24	51.15	.	.	.	.	0	110	.	.
4.E.2.3	Grassland to Settlement - Mineral soil	.	22.40	.	.	.	.	0	129	.	.
4.E.2.4	Wetland to Settlement - Living biomass	.	0.04	.	.	.	.	0	201	.	.
	Wetland to Settlement - Mineral soil	.	1.72	.	.	.	.	0	219	.	.
	Wetland to Settlement - Organic soil	0.81	14.26	.	.	.	.	0	143	.	.
4.F.2	Grassland to Other land - Mineral soil	0.15	1.14	.	.	.	.	0	174	.	.

	Grassland to Other land - Organic soil	3.52	24.53	.	.	.	.	0	202	.	.
4.G	Harwested Wood Products - HWP	-1000.00	407.00	.	.	.	.	0	52	.	.

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

1 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.

2 Uncertainties in input parameters

2.1.1 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.

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.

2.1.2 Standard deviation and probability density

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

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.

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

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.

2.1.3 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

IPCC Source category	Pollutant source	Standard deviation (2σ). per cent[1]	Density shape	Source/ comment
				(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

IPCC Source category	Pollutant source	Standard deviation (2σ). per cent[1]	Density shape	Source/ comment
				(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)
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

IPCC Source category	Pollutant source	Standard deviation (2σ). per cent[1]	Density shape	Source/ comment
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
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

IPCC Source category	Pollutant source	Standard deviation (2σ). per cent[1]	Density shape	Source/ comment
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)

2.1.4 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,

IPCC Source category	Pollutant source	Gas	(2σ). per cent[1]	Density shape	Source/ comment
					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
1B2C	Flaring, well testing	CH_4	Fac2	Truncated N	Expert judgement, Statistics Norway (2000)

IPCC Source category	Pollutant source	Gas	(2σ). per cent[1]	Density shape	Source/ comment
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

IPCC Source category	Pollutant source	Gas	(2σ). per cent[1]	Density shape	Source/ comment
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)

IPCC Source category	Pollutant source	Gas	(2σ). per cent[1]	Density shape	Source/ comment
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)
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	50	Lognormal	IPCC (2000) and expert

IPCC Source category	Pollutant source	Gas	(2σ). per cent[1]	Density shape	Source/ comment
	CH_4				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

2.1.5 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).

2.1.6 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

2.1.7 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.

2.1.8 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.

2.1.9 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.

2.1.10 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.

3 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

IPCC	Source Category	Pollutant source
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	
2B2	Nitric acid production	
2B4	Silicium carbide production	
2B4	Calcium carbide production	
2B5	Methanol and plastic production	
2C1	Iron and steel production	

IPCC	Source Category	Pollutant source
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	

IPCC	Source Category	Pollutant source
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	
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	CO_2	205	112	-9	8	0.037	-45	-49	-41
1A1A_VT3	Gas combustion	Public electricity and heat prod	CO_2	-	1,119	-1	1	0.046	…	-	-
1A1A_VT6	Oil combustion	Public electricity and heat prod	CO_2	14	110	-4	4	0.017	662	635	686
1A1A_VT7	Waste combustion	Public electricity and heat prod	CO_2	97	429	-28	29	**0.499**	344	314	378
1A1B_VT1	Coal/coke combustion	Petroleum refining	CO_2	161	247	-1	2	0.014	53	51	56
1A1B_VT6	Oil combustion	Petroleum refining	CO_2	793	767	-1	1	0.042	-3	-5	-2
1A1C_VT3	Gas combustion	Manufacture of solid fuels and other energy	CO_2	5,185	10,541	-2	3	**1.052**	103	103	104
1A1C_VT6	Oil combustion	Manufacture of solid fuels and other energy	CO_2	251	788	-3	3	0.101	213	207	220
1A2A_VT1	Coal/coke combustion	Iron and steel	CO_2	60	12	-17	17	0.008	-79	-81	-78
1A2A_VT3	Gas combustion	Iron and steel	CO_2	-	3	-5	5	0.001	…	-	-

	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)
1A2A_VT6	Oil combustion	Iron and steel	CO_2	45	59	-3	3	0.007	31	30	32
1A2B_VT1	Coal/coke combustion	Non-ferrous metal	CO_2	0	-	...	...	-	-100	-100	-100
1A2B_VT3	Gas combustion	Non-ferrous metal	CO_2	-	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	CO_2	133	110	-8	8	0.036	-17	-23	-11
1A2C_VT3	Gas combustion	Chemicals	CO_2	-	369	-2	2	0.032	...	-	-
1A2C_VT6	Oil combustion	Chemicals	CO_2	1,064	837	-14	15	0.468	-21	-36	-4
1A2D_VT1	Coal/coke combustion	Pulp, paper, print	CO_2	16	-	...	...	-	-100	-100	-100
1A2D_VT3	Gas combustion	Pulp, paper, print	CO_2	-	3	-4	4	0.000	...	-	-
1A2D_VT6	Oil combustion	Pulp, paper, print	CO_2	210	336	-3	3	0.039	60	58	61
1A2E_VT1	Coal/coke combustion	Food prosessing, beverages, tobacco	CO_2	10	-	...	...	-	-100	-100	-100
1A2E_VT3	Gas combustion	Food prosessing, beverages, tobacco	CO_2	-	89	-5	5	0.018	...	-	-
1A2E_VT6	Oil combustion	Food prosessing, beverages, tobacco	CO_2	456	237	-4	4	0.036	-48	-50	-46
1A2F_VT1	Coal/coke combustion	Other manufacturing	CO_2	396	335	-2	2	0.029	-16	-16	-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)
1A2F_VT3	Gas combustion	Other manufacturing	CO_2	-	69	-6	5	0.015	…	-	-
1A2F_VT6	Oil combustion	Other manufacturing	CO_2	1,135	815	-4	4	0.118	-28	-30	-26
1A2F_VT7	Waste combustion	Other manufacturing	CO_2	-	47	-25	25	0.047	…	-	-
1A3A	Transport fuel - civil aviation		CO_2	679	1,071	-16	17	**0.700**	58	25	104
1A3B	Transport fuel - road transportation		CO_2	7,630	9,697	-5	5	**1.872**	27	20	34
1A3C	Transport fuel - railway		CO_2	96	45	-5	5	0.009	-53	-56	-50
1A3D	Transport fuel - navigation		CO_2	1,696	2,001	-16	17	**1.310**	18	-7	50
1A3E	Transport fuel - motorized equipment and pipeline		CO_2	760	1,211	-15	16	**0.773**	59	24	102
1A4A_VT1	Coal/coke combustion	Commercial/institutional	CO_2	-	5	-19	21	0.004	…	-	-
1A4A_VT3	Gas combustion	Commercial/institutional	CO_2	-	50	-10	10	0.020	…	-	-
1A4A_VT6	Oil combustion	Commercial/institutional	CO_2	812	734	-16	17	**0.496**	-10	-29	15
1A4A_VT7	Waste combustion	Commercial/institutional	CO_2	3	-	…	…	-	-100	-100	-100
1A4B_VT1	Coal/coke combustion	Residential	CO_2	24	2	-21	22	0.001	-93	-95	-91
1A4B_VT3	Gas combustion	Residential	CO_2	-	8	-27	30	0.009	…	-	-

	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)
1A4B_VT6	Oil combustion	Residential	CO_2	1,318	454	-8	9	0.150	-66	-69	-61
1A4C_VT1	Coal/coke combustion	Agriculture/forestry/fishing	CO_2	12	-	...	...	-	-100	-100	-100
1A4C_VT3	Gas combustion	Agriculture/forestry/fishing	CO_2	-	42	-31	29	0.050	...	-	-
1A4C_VT6	Oil combustion	Agriculture/forestry/fishing	CO_2	1,975	1,883	-8	9	**0.646**	-5	-15	7
1A5A	Military fuel - stationary	Military	CO_2	62	35	-7	7	0.010	-44	-48	-40
1A5B	Military fuel - mobile	Military	CO_2	394	228	-7	7	0.063	-42	-46	-38
1B1A	Coal mining, Extraction of natural gas		CO_2	7	5	-51	93	0.013	-38	-40	-35
1B2A_x	Extraction of oil - transport		CO_2	367	124	-34	50	**0.199**	-66	-68	-65
1B2A_y	Extraction of oil - refining/storage		CO_2	749	873	-32	44	**1.343**	17	12	22
1B2A_z	Extraction of oil - distribution gasoline		CO_2	30	14	-35	44	0.023	-52	-55	-50
1B2B	Coal mining, Extraction of natural gas		CO_2	4	13	-51	84	0.034	211	198	225
1B2C_x	Venting		CO_2	27	117	-52	86	0.319	332	332	332
1B2C_z	Well testing		CO_2	80	20	-31	30	0.024	-75	-84	-61

	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)
1B2C_y	Flaring		CO_2	1,393	1,266	-4	5	0.233	-9	-11	-7
2A1	Cement production		CO_2	634	842	-1	1	0.024	33	32	34
2A2	Lime production		CO_2	47	137	-1	1	0.003	194	192	195
2A3	Limestone and dolomite use		CO_2	24	31	-15	15	0.019	30	6	57
2A7	Other mineral production		CO_2	2	2	-7	7	0.001	-15	-15	-15
2B1	Ammonia production		CO_2	500	335	-8	7	0.098	-33	-36	-30
2B4_x	Silicium carbide production		CO_2	222	51	-10	10	0.021	-77	-78	-76
2B4_y	Calcium carbide production		CO_2	178	-	...	...	-	-100	-100	-100
2B5	Methanol and plastic production		CO_2	3	95	-8	9	0.033	3,516	3,080	3,968
2C1	Iron and steel production		CO_2	213	270	-2	2	0.019	27	25	29
2C2	Ferroalloys production		CO_2	2,554	1,446	-3	3	0.171	-43	-43	-43
2C3	Aluminium production		CO_2	1,419	1,725	-10	11	**0.718**	22	17	27
2C5_x	Mg production		CO_2	128	-	...	...	-	-100	-100	-100
2C5_y	Ni production, anodes		CO_2	26	95	-14	14	0.053	270	221	322
2D1	Pulp and paper		CO_2	10	9	-10	9	0.003	-14	-15	-13

	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)
2D2	Carbonic acid, bio protein		CO_2	67	172	-13	14	0.093	157	123	196
3A	Paint application		CO_2	39	17	-10	9	0.007	-56	-56	-56
3B	Degreasing and dry cleaning		CO_2	-	1	-10	10	0.000	…	-	-
3C	Chemical products, Manufaqcture and processing		CO_2	8	1	-10	10	0.000	-89	-89	-89
3D	Other		CO_2	100	96	-10	10	0.038	-4	-4	-4
5A1-1	Forest Land remaining Forest Land, Forest inventory area, Living Biomass		CO_2	-6,413	-22,172	15	-13	12.691	246	246	246
5A1-2	Forest Land remaining Forest Land, Forest inventory area, Dead Biomass		CO_2	-2,042	-1,002	49	-49	1.986	-51	-51	-51
5A1-4	Forest Land remaining Forest Land, Forest inventory area, Soils, Mineral		CO_2	-3,056	-4,584	24	-25	4.510	50	50	50
5A1-3	Forest Land remaining Forest Land, Forest inventory area, Soils, Organic		CO_2	136	144	-103	100	0.585	6	6	6

	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)
5A2-BM	Land converted to Forest Land, Living biomass		CO_2	-5	-365	26	-24	0.358	6,740	6,740	6,740
5A2-S	Land converted to Forest Land, Soils, Mineral		CO_2	30	71	-50	51	0.139	136	136	136
5B-IV	Cropland remaining Cropland, Liming		CO_2	217	83	-11	12	0.036	-62	-64	-59
5B1-1	Cropland remaining Cropland, Horticulture, Living biomass		CO_2	-24	-18	24	-25	0.018	-23	-23	-23
5B1-3	Cropland remaining Cropland, Reduced tillage, Soils		CO_2	-	-180	55	-57	0.398	…	-	-
5B1-5	Cropland remaining Cropland, Erosion of new agriculture land, Soils		CO_2	6	1	0	0	-	-86	-86	-86
5B1-4	Cropland remaining Cropland, Histosols, Soils		CO_2	208	208	-81	80	0.659	-	-	-
5B2-BM	Land converted to Cropland, Living biomass		CO_2	52	-2	25	-24	0.002	-104	-104	-104

	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)
5B2-S	Land converted to Cropland, Soils, Mineral		CO_2	1	28	-49	46	0.055	1,807	1,807	1,807
5C1-1	Grassland remaining Grassland, Other Grassland, Living biomass		CO_2	126	-	...	...	-	-100	-100	-100
5C1-2	Grassland remaining Grassland, Histosols, Soils		CO_2	1,870	1,870	-84	81	5.790	-	-	-
5D1-2	Wetland remaining Wetland, Peat extraction, Soils		CO_2	3	3	-79	74	0.010	-	-	-
5E2-BM	Land converted to Settlements, Living biomass		CO_2	271	299	-49	46	0.556	11	11	11
5E2-S	Land converted to Settlements, Soils		CO_2	39	259	-47	46	0.482	570	570	570
5F2	Land converted to Other land, Living biomass		CO_2	-	-4	46	-50	0.008	...	-	-
5G-IV	Other; Liming of lakes and rivers		CO_2	10	17	-10	12	0.007	64	54	77
6C	Waste incineration		CO_2	0	-	...	...	-	-100	-100	-100

	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)
1A1A_VT1	Coal/coke combustion	Public electricity and heat prod	CH_4	0	0	-55	89	0.000	-33	-37	-28
1A1A_VT2	Wood combustion	Public electricity and heat prod	CH_4	0	2	-56	101	0.005	244	131	415
1A1A_VT3	Gas combustion	Public electricity and heat prod	CH_4	-	9	-51	99	0.027	...	-	-
1A1A_VT6	Oil combustion	Public electricity and heat prod	CH_4	0	0	-61	56	0.000	742	712	768
1A1A_VT7	Waste combustion	Public electricity and heat prod	CH_4	2	4	-54	87	0.011	106	92	121
1A1B_VT6	Oil combustion	Petroleum refining	CH_4	5	1	-58	61	0.002	-86	-86	-86
1A1C_VT3	Gas combustion	Manufacture of solid fuels and other energy	CH_4	41	82	-53	82	0.223	101	100	101
1A1C_VT6	Oil combustion	Manufacture of solid fuels and other energy	CH_4	0	0	-61	56	0.000	-100	-100	-100
1A2A_VT1	Coal/coke combustion	Iron and steel	CH_4	0	0	-55	90	0.000	-53	-56	-51
1A2A_VT2	Wood combustion	Iron and steel	CH_4	0	0	-59	97	0.000	269	144	453
1A2A_VT3	Gas combustion	Iron and steel	CH_4	-	0	-54	84	0.000	...	-	-
1A2A_VT6	Oil combustion	Iron and steel	CH_4	0	0	-61	56	0.000	-22	-22	-21

	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)
1A2B_VT2	Wood combustion	Non-ferrous metal	CH_4	-	0	-55	108	0.000	…	-	-
1A2B_VT3	Gas combustion	Non-ferrous metal	CH_4	-	0	-52	92	0.000	…	-	-
1A2B_VT6	Oil combustion	Non-ferrous metal	CH_4	0	0	-62	57	0.000	-39	-41	-37
1A2C_VT1	Coal/coke combustion	Chemicals	CH_4	0	0	-55	90	0.000	-11	-17	-4
1A2C_VT2	Wood combustion	Chemicals	CH_4	0	0	-58	98	0.001	295	166	519
1A2C_VT3	Gas combustion	Chemicals	CH_4	-	0	-52	94	0.001	…	-	-
1A2C_VT6	Oil combustion	Chemicals	CH_4	1	1	-60	66	0.003	-6	-23	15
1A2D_VT1	Coal/coke combustion	Pulp, paper, print	CH_4	0	-	…	…	-	-100	-100	-100
1A2D_VT2	Wood combustion	Pulp, paper, print	CH_4	6	5	-57	99	0.015	-17	-45	30
1A2D_VT3	Gas combustion	Pulp, paper, print	CH_4	-	0	-53	77	0.000	…	-	-
1A2D_VT6	Oil combustion	Pulp, paper, print	CH_4	0	0	-61	56	0.000	107	105	108
1A2E_VT1	Coal/coke combustion	Food prosessing, beverages, tobacco	CH_4	0	-	…	…	-	-100	-100	-100
1A2E_VT2	Wood combustion	Food prosessing, beverages, tobacco	CH_4	0	0	-57	97	0.000	-96	-97	-93
1A2E_VT3	Gas combustion	Food prosessing, beverages, tobacco	CH_4	-	0	-53	88	0.001	…	-	-

	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)
1A2E_VT6	Oil combustion	Food prosessing, beverages, tobacco	CH_4	0	0	-62	56	0.000	-41	-43	-39
1A2F_VT1	Coal/coke combustion	Other manufacturing	CH_4	0	0	-54	90	0.001	22	21	23
1A2F_VT2	Wood combustion	Other manufacturing	CH_4	1	1	-57	93	0.003	-29	-52	9
1A2F_VT3	Gas combustion	Other manufacturing	CH_4	-	0	-53	88	0.000	...	-	-
1A2F_VT6	Oil combustion	Other manufacturing	CH_4	2	2	-61	55	0.004	-5	-8	-2
1A2F_VT7	Waste combustion	Other manufacturing	CH_4	-	1	-53	86	0.001	...	-	-
1A3A	Transport fuel - civil aviation		CH_4	0	1	-53	90	0.002	86	47	140
1A3B	Transport fuel - road transportation		CH_4	71	18	-35	49	0.031	-75	-76	-73
1A3C	Transport fuel - railway		CH_4	0	0	-54	85	0.000	-53	-56	-50
1A3D	Transport fuel - navigation		CH_4	4	52	-54	90	0.145	1,061	816	1,374
1A3E	Transport fuel - motorized equipment and pipeline		CH_4	7	9	-53	87	0.027	33	4	70
1A4A_VT1	Coal/coke combustion	Commercial/institutional	CH_4	-	0	-52	84	0.000	...	-	-
1A4A_VT2	Wood combustion	Commercial/institutional	CH_4	0	0	-56	93	0.001	9,944	6,531	15,274
1A4A_VT3	Gas combustion	Commercial/institutional	CH_4	-	0	-51	87	0.000	...	-	-

	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_VT6	Oil combustion	Commercial/institutional	CH_4	2	2	-58	68	0.005	-11	-30	13
1A4A_VT7	Waste combustion	Commercial/institutional	CH_4	0	-	...	...	-	-100	-100	-100
1A4B_VT1	Coal/coke combustion	Residential	CH_4	2	0	-55	83	0.000	-94	-95	-91
1A4B_VT2	Wood combustion	Residential	CH_4	111	142	-54	104	0.446	27	-12	90
1A4B_VT3	Gas combustion	Residential	CH_4	-	0	-55	98	0.000	...	-	-
1A4B_VT6	Oil combustion	Residential	CH_4	3	1	-58	65	0.003	-66	-70	-61
1A4C_VT1	Coal/coke combustion	Agriculture/forestry/fishing	CH_4	0	-	...	...	-	-100	-100	-100
1A4C_VT2	Wood combustion	Agriculture/forestry/fishing	CH_4	-	0	-58	105	0.000	...	-	-
1A4C_VT3	Gas combustion	Agriculture/forestry/fishing	CH_4	-	0	-53	96	0.000	...	-	-
1A4C_VT6	Oil combustion	Agriculture/forestry/fishing	CH_4	4	3	-57	64	0.008	-16	-25	-5
1A5A	Military fuel - stationary	Military	CH_4	0	0	-52	95	0.000	-29	-34	-24
1A5B	Military fuel - mobile	Military	CH_4	0	0	-50	88	0.001	-36	-41	-32
1B1A	Coal mining, Extraction of natural gas		CH_4	56	35	-51	93	0.098	-38	-40	-35
1B2A_x	Extraction of oil - transport		CH_4	129	153	-34	50	0.246	18	14	23
1B2A_y	Extraction of oil -		CH_4	35	48	-33	41	0.072	36	31	42

	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)
	refining/storage										
1B2B	Coal mining, Extraction of natural gas		CH_4	3	47	-50	85	0.124	1,753	1,680	1,837
1B2C_x	Venting		CH_4	143	331	-52	86	**0.904**	131	131	131
1B2C_z	Well testing		CH_4	0	0	-60	68	0.000	-75	-84	-61
1B2C_y	Flaring		CH_4	10	14	-60	53	0.031	40	37	43
2B4_x	Silicium carbide production		CH_4	7	2	-11	10	0.001	-77	-78	-76
2B5	Methanol and plastic production		CH_4	2	3	-53	83	0.008	74	53	96
2C2	Ferroalloys production		CH_4	1	1	-51	85	0.002	-23	-23	-23
4A1	Enteric fermentation - cattle		CH_4	1,420	1,268	-23	24	**1.194**	-11	-16	-4
4A10	Enteric fermentation - other animal		CH_4	102	111	-40	40	0.171	9	2	17
4A3	Enteric fermentation - sheep		CH_4	431	461	-24	24	0.458	7	-0	14
4A4	Enteric fermentation - goat		CH_4	9	7	-39	40	0.011	-24	-29	-19
4A6	Enteric fermentation - horse		CH_4	12	25	-40	38	0.039	109	97	124
4A8	Enteric fermentation - swine		CH_4	17	22	-38	40	0.035	32	23	42

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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)
4A9	Enteric fermentation - poultry		CH_4	1	2	-40	37	0.003	49	39	59
4B1	Manure management - CH_4 - cattle		CH_4	215	194	-25	25	0.187	-10	-15	-3
4B13	Manure management - CH_4 - other animal		CH_4	4	5	-24	25	0.005	19	11	28
4B3	Manure management - CH_4 - sheep		CH_4	24	24	-23	25	0.024	0	-6	7
4B4	Manure management - CH_4 - goat		CH_4	2	1	-24	26	0.001	-31	-35	-26
4B6	Manure management - CH_4 - horse		CH_4	11	23	-25	26	0.023	109	97	124
4B8	Manure management - CH_4 - swine		CH_4	23	29	-26	23	0.028	30	21	39
4B9	Manure management - CH_4 - poultry		CH_4	19	37	-26	25	0.036	97	83	110
4F1	Burning of straw		CH_4	23	3	-54	87	0.010	-85	-87	-83
5A1-V	Forest Land remaining Forest Land, Wildfires		CH_4	2	3	-54	100	0.008	42	8	92

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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)
6A	Managed waste disposal on land		CH_4	1,682	1,065	-31	38	**1.457**	-37	-52	-17
6B_x	Waste water - CH4		CH_4	20	10	-39	57	0.018	-50	-50	-49
6C	Waste incineration		CH_4	0	0	-55	93	0.000	522	304	869
1A1A_VT1	Coal/coke combustion	Public electricity and heat prod	N_2O	1	1	-74	105	0.002	-46	-50	-42
1A1A_VT2	Wood combustion	Public electricity and heat prod	N_2O	2	5	-74	125	0.019	162	76	292
1A1A_VT3	Gas combustion	Public electricity and heat prod	N_2O	-	3	-73	116	0.011	...	-	-
1A1A_VT6	Oil combustion	Public electricity and heat prod	N_2O	0	0	-71	109	0.001	528	506	548
1A1A_VT7	Waste combustion	Public electricity and heat prod	N_2O	4	6	-74	123	0.026	54	43	65
1A1B_VT1	Coal/coke combustion	Petroleum refining	N_2O	0	0	-72	121	0.002	53	51	56
1A1B_VT6	Oil combustion	Petroleum refining	N_2O	5	2	-73	121	0.009	-57	-57	-56
1A1C_VT3	Gas combustion	Manufacture of solid fuels and other energy	N_2O	14	27	-74	121	0.107	101	101	102

	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)
1A1C_VT6	Oil combustion	Manufacture of solid fuels and other energy	N_2O	1	2	-71	107	0.007	181	176	187
1A2A_VT1	Coal/coke combustion	Iron and steel	N_2O	0	0	-72	116	0.001	-53	-56	-51
1A2A_VT2	Wood combustion	Iron and steel	N_2O	0	0	-74	114	0.000	269	144	453
1A2A_VT3	Gas combustion	Iron and steel	N_2O	-	0	-74	117	0.000	...	-	-
1A2A_VT6	Oil combustion	Iron and steel	N_2O	0	0	-70	107	0.000	-57	-58	-57
1A2B_VT2	Wood combustion	Non-ferrous metal	N_2O	-	0	-75	134	0.001	...	-	-
1A2B_VT3	Gas combustion	Non-ferrous metal	N_2O	-	0	-69	128	0.001	...	-	-
1A2B_VT6	Oil combustion	Non-ferrous metal	N_2O	1	0	-70	107	0.001	-71	-72	-69
1A2C_VT1	Coal/coke combustion	Chemicals	N_2O	1	1	-72	115	0.002	-11	-17	-4
1A2C_VT2	Wood combustion	Chemicals	N_2O	0	1	-74	124	0.003	295	166	519
1A2C_VT3	Gas combustion	Chemicals	N_2O	-	0	-72	116	0.001	...	-	-
1A2C_VT6	Oil combustion	Chemicals	N_2O	1	2	-71	125	0.008	64	33	100
1A2D_VT1	Coal/coke combustion	Pulp, paper, print	N_2O	0	-	...	...	-	-100	-100	-100
1A2D_VT2	Wood combustion	Pulp, paper, print	N_2O	27	20	-75	132	0.078	-28	-52	13
1A2D_VT3	Gas combustion	Pulp, paper, print	N_2O	-	0	-70	120	0.000	...	-	-

	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)
1A2D_VT6	Oil combustion	Pulp, paper, print	N_2O	1	1	-70	107	0.004	56	55	57
1A2E_VT1	Coal/coke combustion	Food prosessing, beverages, tobacco	N_2O	0	-	...	...	-	-100	-100	-100
1A2E_VT2	Wood combustion	Food prosessing, beverages, tobacco	N_2O	0	0	-76	125	0.000	-96	-97	-93
1A2E_VT3	Gas combustion	Food prosessing, beverages, tobacco	N_2O	-	0	-71	115	0.000	...	-	-
1A2E_VT6	Oil combustion	Food prosessing, beverages, tobacco	N_2O	1	1	-71	106	0.003	-47	-49	-45
1A2F_VT1	Coal/coke combustion	Other manufacturing	N_2O	0	0	-72	119	0.001	146	143	148
1A2F_VT2	Wood combustion	Other manufacturing	N_2O	6	4	-75	123	0.017	-29	-52	9
1A2F_VT3	Gas combustion	Other manufacturing	N_2O	-	0	-73	115	0.000	...	-	-
1A2F_VT6	Oil combustion	Other manufacturing	N_2O	3	2	-71	108	0.008	-28	-30	-25
1A2F_VT7	Waste combustion	Other manufacturing	N_2O	-	1	-71	118	0.004	...	-	-
1A3A	Transport fuel - civil aviation		N_2O	7	11	-74	113	0.041	58	25	104
1A3B	Transport fuel - road transportation		N_2O	57	59	-51	70	**0.146**	5	-2	10

	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)
1A3C	Transport fuel - railway		N_2O	11	5	-84	99	0.020	-53	-56	-50
1A3D	Transport fuel - navigation		N_2O	11	14	-73	129	0.058	30	3	65
1A3E	Transport fuel - motorized equipment and pipeline		N_2O	69	125	-77	110	0.487	81	41	130
1A4A_VT1	Coal/coke combustion	Commercial/institutional	N_2O	-	0	-72	128	0.000	...	-	-
1A4A_VT2	Wood combustion	Commercial/institutional	N_2O	0	0	-74	136	0.002	4,429	2,890	6,832
1A4A_VT3	Gas combustion	Commercial/institutional	N_2O	-	0	-73	118	0.000	...	-	-
1A4A_VT6	Oil combustion	Commercial/institutional	N_2O	2	2	-72	113	0.008	-10	-29	15
1A4A_VT7	Waste combustion	Commercial/institutional	N_2O	0	-	...	...	-	-100	-100	-100
1A4B_VT1	Coal/coke combustion	Residential	N_2O	0	0	-72	127	0.000	-94	-95	-91
1A4B_VT2	Wood combustion	Residential	N_2O	10	13	-73	130	0.051	29	-11	92
1A4B_VT3	Gas combustion	Residential	N_2O	-	0	-75	129	0.000	...	-	-
1A4B_VT6	Oil combustion	Residential	N_2O	4	1	-71	110	0.005	-65	-69	-61
1A4C_VT1	Coal/coke combustion	Agriculture/forestry/fishing	N_2O	0	-	...	...	-	-100	-100	-100
1A4C_VT2	Wood combustion	Agriculture/forestry/fishing	N_2O	-	0	-74	118	0.000	...	-	-
1A4C_VT3	Gas combustion	Agriculture/forestry/fishing	N_2O	-	0	-72	120	0.000	...	-	-

	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)
1A4C_VT6	Oil combustion	Agriculture/forestry/fishing	N_2O	67	61	-71	112	0.231	-9	-19	2
1A5A	Military fuel - stationary	Military	N_2O	0	0	-73	114	0.001	21	13	30
1A5B	Military fuel - mobile	Military	N_2O	6	4	-76	104	0.015	-31	-36	-27
1B2C_z	Well testing		N_2O	0	0	-74	136	0.000	-75	-84	-61
1B2C_y	Flaring		N_2O	4	4	-75	112	0.013	-15	-16	-13
2B2	Nitric acid production		N_2O	2,074	460	-6	6	0.108	-78	-78	-78
2B5	Methanol and plastic production		N_2O	-	1	-9	9	0.000	...	-	-
2C2	Ferroalloys production		N_2O	5	4	-10	10	0.001	-28	-28	-28
3D	Other		N_2O	36	44	-15	15	0.026	25	25	25
4B11	Manure management - N_2O Liquid storage		N_2O	17	18	-53	80	0.047	1	-5	6
4B12	Manure management - N_2O - solid storage		N_2O	116	109	-52	84	0.290	-6	-11	-1
4D1_x	Direct soil emission - Fertilizer		N_2O	665	595	-82	220	**3.633**	-11	-16	-4
4D1_y	Direct soil emission - Manure		N_2O	240	232	-82	219	**1.417**	-4	-9	1

	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)
4D1_xx	Direct soil emission- Other		N_2O	160	138	-84	245	**0.944**	-13	-63	109
4D1_z	Direct soil emission- Organic soil		N_2O	332	287	-86	228	**1.961**	-14	-68	120
4D2	Animal production		N_2O	223	206	-54	84	**0.569**	-8	-13	-3
4D3_x	Indirect soil emission- Deposition		N_2O	71	82	-70	142	0.345	15	10	21
4D3_y	Indirect soil emission - Leaching, other		N_2O	346	322	-69	170	**1.496**	-7	-11	-3
4F1	Burning of straw		N_2O	9	1	-70	112	0.005	-85	-87	-83
5A2-I	Forest Land remaining Forest Land, Fertilizer		N_2O	1	1	-83	219	0.004	-58	-58	-58
5A-II	Forest Land remaining Forest Land, Drainage		N_2O	11	12	-87	317	0.111	6	6	6
5A1-V	Forest Land remaining Forest Land, Wildfires		N_2O	0	0	-55	95	0.001	42	8	92
5B2-III	Cropland, Disturbance		N_2O	1	0	-90	328	0.001	-86	-86	-86
5D-II	Land converted to Wetland, Drainage		N_2O	0	0	-89	309	0.001	-	-	-

	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_z	Waste water - N_2O plant		N_2O	-	37	-55	88	0.109	…	-	-
6B_y	Waste water - N_2O pipeline		N_2O	91	97	-56	95	0.302	7	-24	51
6B_w	Waste water - N_2O not connected		N_2O	26	25	-80	209	0.157	-5	-38	50
6C	Waste incineration		N_2O	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 SF_6		PFK	-	0	-39	55	0.000	…	-	-
2C4	SF_6 used in Al and Mg foundries		SF_6	2,144	-	…	…	-	-100	-100	-100
2F	Consumption of halocarbons and SF_6		SF_6	56	64	-47	70	0.148	15	15	15

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Annex III: Energy Balance Sheets 1990 - 2013

This annex is subdivided into two parts. Part 1 presents the energy balance sheets for the years 1990-2013 in a regular format. Part 2 contains energy balance sheets for the years 2008-2013 with more detailed energy products than in Part 1. In the first page of Part 2 footnotes to Part 2 is given. The table below together with the footnotes explains the connection between energy products in the two parts.

Part 1 of the energy balance *Regular format of energy products*		**Part 2 of EB** *More detailed energy products*	
Total		**Total**	
Coal	Solid	Coal	
Coke	Solid	Coke	
	Solid	Blast furnace gas	
Petrol coke	Liquid	Petrol coke	
Fuel wood, black liquor, garbage	Biomass	Fuel wood	
	Biomass	Wood waste, black liquor, biogas, biofuels, pellets, etcetera	Biogas incl. Landfill gas
	Other	Waste included hazardous waste	
Crude oil	Liquid	Crude oil	
Petrol	Liquid	Petrol	
Kerosene	Liquid	Kerosene	
Middle distillates	Liquid	Middle distillates	
Heavy fuel oil included hazardous waste	Liquid	Heavy fuel oil	
LPG	Liquid	LPG	
	Liquid	Fuel gas	
	Liquid	Refinery gas	
Natural gas	Gaseous	Natural gas	
Other gases			
Waterfall energy and wind power	Not in CRF	Waterfall energy and wind power	
Electricity	Not in CRF	Electricity	
District heating	Not in CRF	District heating	

Part 1: Energy balance sheets 1990-2013

Energy balance	**1990**										
PJ											
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	Crude oil	Petroleum products	Natural gas and other gases	Waterfall energy	Electricity	District heating
1.1.1 Production of primary energy bearers	4931.45	8.51	0.00	0.00	37.49	3411.87	49.62	986.99	436.97	0.00	0.00
1.1.2 Production of natural gas that is flared off	20.55	0.00	0.00	0.00	0.00	0.00	0.00	20.55	0.00	0.00	0.00
2. Imports	257.78	20.04	15.21	12.84	0.01	68.66	139.82	0.00	0.00	1.20	0.00
3. Exports	4265.55	7.15	0.13	3.99	0.00	2897.27	373.46	925.09	0.00	58.47	0.00
4.1 Bunkering	19.42	0.00	0.00	0.00	0.00	0.00	19.42	0.00	0.00	0.00	0.00
4.2 Foreign aviation	8.48	0.00	0.00	0.00	0.00	0.00	8.48	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-63.93	-0.37	0.00	-0.62	0.00	-62.31	-0.63	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	852.41	21.03	15.08	8.23	37.50	520.95	-212.55	82.45	436.97	-57.27	0.00
8. Energy converted	1017.15	0.58	1.36	0.00	2.11	538.98	35.83	0.01	436.97	1.32	0.00
8.1. In blast furnaces	1.36	0.00	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	574.65	0.00	0.00	0.00	0.00	538.98	35.67	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.01	0.00	0.00	0.00	0.94	0.00	0.07	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	1.08	0.58	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants											
8.6. In hydropow er plants	2.07	0.00	0.00	0.00	0.67	0.00	0.08	0.01	0.00	1.32	0.00
8.7. Other conversion											
1.2. Production of derived energy bearers	1034.56	0.00	0.00	5.65	0.00	0.00	542.15	43.02	0.00	438.65	5.09
9. Consumption by energy sector	140.74	0.00	0.00	0.00	0.00	0.00	3.88	129.83	0.00	7.03	0.00
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	28.91	0.00	0.00	0.00	0.00	0.00	0.00	2.19	0.00	24.75	1.97
11. Statistical differences (7-8+1.2-9-10-13.1)	-27.97	-0.75	0.77	0.34	-0.07	-18.03	11.67	-21.69	0.00	-0.22	0.00
	-27.97	-0.75	0.77	0.34	-0.07	-18.03	11.67	-21.69	0.00	-0.22	0.00
13.1 Net domestic consumption including non-energy use	728.13	21.20	12.95	13.54	35.46	0.00	278.23	15.13	0.00	348.51	3.12
13. Net domestic consumption	681.33	21.20	0.00	13.31	35.46	0.00	244.60	15.13	0.00	348.51	3.12
14. Manufacturing, mining and quarrying	260.31	20.87	0.00	13.26	15.04	0.00	32.60	15.12	0.00	162.76	0.68
14.1. Mining and quarrying	4.45	0.00	0.00	0.00	0.00	0.00	1.90	0.00	0.00	2.55	0.00
14.2. Manufacture of paper and paper products	36.96	0.18	0.00	0.00	10.29	0.00	2.62	0.00	0.00	23.86	0.00
14.3. Manufacture of industrial chemicals	38.83	0.00	0.00	1.28	0.15	0.00	4.52	13.97	0.00	18.61	0.30
14.4. Manufacture of iron, steel and ferro alloys	55.28	13.57	0.00	10.90	0.01	0.00	1.10	0.44	0.00	29.25	0.02
14.5. Manufacture of aluminium and other non-ferrous metals	64.78	0.00	0.00	0.41	0.00	0.00	3.11	0.72	0.00	60.54	0.00
14.6. Other manufacturing industries	60.01	7.11	0.00	0.68	4.59	0.00	19.34	0.00	0.00	27.94	0.35
15. Transport	147.97	0.00	0.00	0.00	0.00	0.00	145.63	0.00	0.00	2.35	0.00
15.1. Railw ays and subw ays	3.14	0.00	0.00	0.00	0.00	0.00	1.37	0.00	0.00	1.77	0.00
15.2. Air transport	9.30	0.00	0.00	0.00	0.00	0.00	9.30	0.00	0.00	0.00	0.00
15.3. Road transport	108.62	0.00	0.00	0.00	0.00	0.00	108.04	0.00	0.00	0.58	0.00
15.4. Coastal shipping	26.92	0.00	0.00	0.00	0.00	0.00	26.92	0.00	0.00	0.00	0.00
16. Other sectors	273.05	0.33	0.00	0.05	20.42	0.00	66.38	0.00	0.00	183.41	2.44
16.1. Fishing	18.71	0.00	0.00	0.00	0.00	0.00	18.71	0.00	0.00	0.00	0.00
16.2. Agriculture	10.53	0.13	0.00	0.00	0.00	0.00	7.93	0.00	0.00	2.45	0.02
16.3. Households	149.48	0.20	0.00	0.05	20.42	0.00	18.70	0.00	0.00	109.08	1.03
16.4. Other consumers	88.32	0.00	0.00	0.00	0.00	0.00	16.95	0.00	0.00	69.97	1.39
16.5 Construction	6.00	0.00	0.00	0.00	0.00	0.00	4.09	0.00	0.00	1.91	0.00
12. Consumption for non-energy purposes	46.80	0.00	0.00	13.18	0.00	0.00	33.62	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals											
12.2 Other manufacturing											

Energy balance	**1991**										
PJ											
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	Crude oil	Petroleum products	Natural gas and other gases	Waterfall energy	Electricity	District heating
1.1.1 Production of primary energy bearers	5 405.29	9.27	-	-	35.57	3 899.13	49.23	1 014.00	398.09	-	-
1.1.2 Production of natural gas that is flared off	13.45	-	-	-	-	-	-	13.45	-	-	-
2. Imports	251.15	16.89	13.82	12.02	0.01	68.57	128.04	-	-	11.79	-
3. Exports	4 757.17	7.61	0.16	3.06	0.01	3 459.16	332.90	932.49	-	21.78	-
4.1 Bunkering	16.40	-	-	-	-	-	16.40	-	-	-	-
4.2 Foreign aviation	7.66	-	-	-	-	-	7.66	-	-	-	-
5. Changes in stocks (+ net decrease, - net increase)	14.26	0.59	-0.00	-0.08	-	9.95	3.80	-	-	-	-
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	902.93	19.13	13.66	8.88	35.58	518.49	-175.88	94.97	398.09	-9.99	-
8. Energy converted	949.38	0.75	1.52	-	2.12	510.22	35.29	0.07	398.09	1.32	-
8.1. In blast furnaces	1.52	-	1.52	-	-	-	-	-	-	-	-
8.2. In crude petroleum refineries	545.26	-	-	-	-	510.22	35.04	-	-	-	-
8.3. In thermal pow er plants	1.01	-	-	-	0.94	-	0.07	-	-	-	-
8.4. In dual purpose pow er plants	1.25	0.75	-	-	0.50	-	-	-	-	-	-
8.5. In district heating plants	2.25	-	-	-	0.67	-	0.19	0.07	-	1.32	-
8.6. In hydropow er plants	398.09	-	-	-	-	-	-	-	398.09	-	-
8.7. Other conversion	-	-	-	-	-	-	-	-	-	-	-
1.2. Production of derived energy bearers	978.09	-	-	4.99	-	-	527.35	40.55	-	399.63	5.56
9. Consumption by energy sector	138.30	-	-	-	-	-	4.41	126.10	-	7.79	-
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	28.26	-	-	-	-	-	-	2.22	-	24.13	1.91
11. Statistical differences (7-8+1.2-9-10-13.1)	48.52	0.09	0.03	0.36	-	8.26	47.62	-7.84	-	-0.01	-0.00
13.1 Net domestic consumption including non-energy use	716.56	18.30	12.10	13.51	33.46	-	264.15	14.97	-	356.42	3.66
13. Net domestic consumption	675.87	18.30	12.10	0.19	33.46	-	236.77	14.97	-	356.42	3.66
14. Manufacturing, mining and quarrying	254.68	17.96	12.07	0.19	15.07	-	32.53	14.96	-	161.12	0.78
14.1. Mining and quarrying	4.52	-	-	-	-	-	1.88	-	-	2.65	-
14.2. Manufacture of paper and paper products	37.49	0.42	-	-	10.42	-	3.13	-	-	23.50	0.00
14.3. Manufacture of industrial chemicals	39.56	-	-	1.06	0.14	-	7.02	13.87	-	17.17	0.29
14.4. Manufacture of iron, steel and ferro alloys	49.50	11.30	-	10.45	0.01	-	0.53	0.42	-	26.76	0.03
14.5. Manufacture of aluminium and other non-ferrous metals	65.62	-	-	0.30	-	-	3.13	0.67	-	61.52	-
14.6. Other manufacturing industries	57.99	6.24	-	0.45	4.50	-	16.84	-	-	29.51	0.45
15. Transport	146.72	-	-	-	-	-	144.42	-	-	2.29	-
15.1. Railw ays and subw ays	3.11	-	-	-	-	-	1.35	-	-	1.76	-
15.2. Air transport	9.54	-	-	-	-	-	9.54	-	-	-	-
15.3. Road transport	107.44	-	-	-	-	-	106.91	-	-	0.53	-
15.4. Coastal shipping	26.62	-	-	-	-	-	26.62	-	-	-	-
16. Other sectors	274.47	0.34	0.03	-	18.39	-	59.82	0.01	-	193.01	2.88
16.1. Fishing	17.30	-	-	-	-	-	17.24	-	-	-	0.06
16.2. Agriculture	9.96	0.15	-	-	-	-	7.41	-	-	2.38	0.02
16.3. Households	153.48	0.18	-	0.03	18.39	-	16.40	-	-	117.41	1.06
16.4. Other consumers	87.98	0.00	-	-	0.00	-	14.93	0.01	-	71.30	1.74
16.5 Construction	5.75	-	-	-	-	-	3.84	-	-	1.91	-
12. Consumption for non-energy purposes	40.70	-	-	13.31	-	-	27.38	-	-	-	-
12.1 Manufacture of industrial chemicals											
12.2 Other manufacturing											

Energy balance	**1992**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel wood, black liquor, waste	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	6038.07	10.08	0.00	0.00	37.18	4472.98	9.31	0.00	0.00	0.00	43.86	1043.22	0.00	421.43	0.00	0.00
1.1.2 Production of natural gas that is flared off	11.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.57	0.00	0.00	0.00	0.00
2. Imports	215.02	17.35	13.38	11.15	0.05	47.40	17.12	6.48	26.31	25.96	44.86	0.00	0.00	0.00	4.97	0.00
3. Exports	5324.13	4.72	0.00	3.88	0.00	3915.64	125.20	14.87	165.44	58.62	54.43	944.92	0.00	0.00	36.39	0.00
4.1 Bunkering	20.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.12	11.36	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	8.25	0.00	0.00	0.00	0.00	0.00	0.00	8.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-29.15	-4.36	0.42	0.02	0.00	-25.15	0.87	-0.55	-0.12	0.02	-0.30	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	882.65	18.35	13.80	7.30	37.23	579.58	-97.90	-17.20	-148.38	-44.01	33.99	109.88	0.00	421.43	-31.43	0.00
8. Energy converted	1045.08	0.75	1.33	0.00	5.23	571.87	9.55	1.58	2.66	29.01	0.25	0.00	0.05	421.43	1.38	0.00
8.1. In blast furnaces	1.33	0.00	1.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	614.79	0.00	0.00	0.00	0.00	571.87	9.55	1.58	2.55	28.99	0.25	0.00	0.00	0.00	0.00	0.00
8.3. In thermal power plants	1.04	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose power plants	2.69	0.75	0.00	0.00	1.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	3.81	0.00	0.00	0.00	2.32	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.05	0.00	1.38	0.00
8.6. In hydropower plants	421.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	421.43	0.00	0.00
8.7. Other conversion																
1.2. Production of derived energy bearers	1063.95	0.00	0.00	5.79	0.00	0.00	185.85	45.15	274.82	67.56	10.25	0.00	45.93	0.00	423.02	5.58
9. Consumption by energy sector	147.73	0.00	0.00	0.00	0.00	0.00	0.16	0.01	3.65	0.23	0.00	106.74	29.04	0.00	7.91	0.00
9.1.1 Crude petroleum and natural gas production	99.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.28	0.08	0.00	95.17	0.00	0.00	0.51	0.00
9.1.2 Natural gas which is flared off on oil fields	11.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.57	0.00	0.00	0.00	0.00
9.2. Coal mines	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.08	0.00
9.3. Petroleum refineries	30.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.15	0.00	0.00	29.04	0.00	1.70	0.00
9.4. Pumping storage power plants	2.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.01	0.00
9.5. Hydro electric power plants	3.65	0.00	0.00	0.00	0.00	0.00	0.15	0.01	0.11	0.00	0.00	0.00	0.00	0.00	3.38	0.00
9.6. Thermal power plants	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
9.7. Combined heat and power plants	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.05	0.00
9.8. District heating plants	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
9.9. Gas supply	28.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.61	0.00	24.53	1.74
10. Losses in transport and distribution																
11. Statistical differences (7-8+1.2-9-10-13.1)	10.11	-0.85	0.37	-0.35	0.00	7.72	3.81	6.67	-3.19	-17.74	10.53	3.14	0.00	0.00	0.00	0.00
	10.11	-0.85	0.37	-0.35	0.00	7.72	3.81	6.67	-3.19	-17.74	10.53	3.14	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	714.80	18.45	12.10	13.44	32.00	0.00	74.43	19.69	123.31	12.05	33.47	0.00	14.24	0.00	357.78	3.85
13. Net domestic consumption	672.77	18.45	12.10	0.26	32.00	0.00	74.43	19.69	123.31	12.05	4.62	0.00	14.24	0.00	357.78	3.85
14. Manufacturing, mining and quarrying	248.08	18.21	12.06	0.26	13.97	0.00	0.00	0.04	13.62	10.73	4.45	0.00	14.18	0.00	159.76	0.79
14.1. Mining and quarrying	4.08	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.88	0.76	0.01	0.00	0.00	0.00	2.42	0.00
14.2. Manufacture of paper and paper products	34.93	0.24	0.00	0.00	9.64	0.00	0.00	0.00	0.18	2.36	0.01	0.00	0.00	0.00	22.51	0.00
14.3. Manufacture of industrial chemicals	35.50	0.00	1.04	0.00	0.00	0.00	0.00	0.00	0.13	1.61	2.16	0.00	13.16	0.00	17.08	0.32
14.4. Manufacture of iron, steel and ferro alloys	49.06	11.71	10.35	0.00	0.00	0.00	0.00	0.00	0.20	0.50	0.00	0.00	0.36	0.00	25.92	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	62.80	0.00	0.41	0.00	0.00	0.00	0.00	0.00	1.64	0.69	0.29	0.00	0.66	0.00	59.12	0.00
14.6. Other manufacturing industries	61.71	6.26	0.26	0.26	4.33	0.00	0.00	0.01	10.60	4.82	1.98	0.00	0.00	0.00	32.71	0.46
15. Transport	150.79	0.00	0.00	0.00	0.00	0.00	73.47	9.72	64.10	1.08	0.00	0.00	0.00	0.00	2.41	0.00
15.1. Railways and subways	3.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.43	0.00	0.00	0.00	0.00	0.00	2.41	0.00
15.2. Air transport	9.84	0.00	0.00	0.00	0.00	0.00	0.12	9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	108.91	0.00	0.00	0.00	0.00	0.00	71.63	0.00	37.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.4. Coastal shipping	28.20	0.00	0.00	0.00	0.00	0.00	1.72	0.00	25.39	1.08	0.00	0.00	0.00	0.00	0.00	0.00
16. Other sectors	273.89	0.23	0.04	0.00	18.03	0.00	0.95	9.93	45.58	0.24	0.17	0.00	0.06	0.00	195.61	3.05
16.1. Fishing	16.24	0.00	0.00	0.00	0.00	0.00	0.16	0.01	15.92	0.11	0.00	0.00	0.00	0.00	0.00	0.04
16.2. Agriculture	9.72	0.10	0.00	0.00	0.00	0.00	0.07	0.04	7.01	0.05	0.00	0.00	0.00	0.00	2.44	0.02
16.3. Households	150.66	0.13	0.04	0.00	18.03	0.00	0.72	6.03	7.06	0.01	0.12	0.00	0.00	0.00	117.54	0.98
16.4. Other consumers	91.73	0.00	0.00	0.00	0.00	0.00	0.00	3.82	11.64	0.07	0.05	0.00	0.06	0.00	74.08	2.01
16.5 Construction	5.55	0.00	0.00	0.00	0.00	0.00	0.01	0.03	3.96	0.00	0.00	0.00	0.00	0.00	1.55	0.00
12. Consumption for non-energy purposes	42.03	0.00	0.00	13.18	0.00	0.00	0.00	0.00	0.00	0.00	28.85	0.00	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	32.91	0.00	0.00	4.06	0.00	0.00	0.00	0.00	0.00	0.00	28.85	0.00	0.00	0.00	0.00	0.00
12.2 Other manufacturing	9.12	0.00	0.00	9.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**1993**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	6325.12	7.52	0.00	0.00	40.88	4747.17	24.67	0.00	0.00	0.00	62.05	1012.17	0.00	430.66	0.00	0.00
1.1.2 Production of natural gas that is flared off	13.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.42	0.00	0.00	0.00	0.00
2. Imports	228.69	20.13	13.21	12.09	0.04	56.36	18.86	2.62	22.28	35.35	45.65	0.00	0.00	0.00	2.11	0.00
3. Exports	5598.63	6.39	0.06	4.80	0.03	4212.32	132.76	17.30	160.78	59.74	65.78	908.14	0.00	0.00	30.55	0.00
4.1 Bunkering	21.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.92	12.02	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	8.69	0.00	0.00	0.00	0.00	0.00	0.00	8.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-33.25	1.85	-0.68	0.62	0.00	-30.60	-5.30	-2.83	3.01	1.05	-0.37	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	904.73	23.11	12.47	7.92	40.89	560.61	-94.54	-26.20	-145.41	-35.35	41.55	117.45	0.00	430.66	-28.44	0.00
8. Energy converted	1051.48	0.71	1.33	0.00	4.58	569.80	6.79	2.15	5.90	26.85	1.36	0.00	0.05	430.66	1.30	0.00
8.1. In blast furnaces	1.33	0.00	1.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	612.75	0.00	0.00	0.00	0.00	569.80	6.79	2.15	5.81	26.84	1.36	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	2.89	0.71	0.00	0.00	2.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	3.78	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.05	0.00	1.30	0.00
8.6. In hydropow er plants	430.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	430.66	0.00	0.00
8.7. Other conversion																
1.2. Production of derived energy bearers	1078.26	0.00	0.00	6.94	0.00	0.00	179.95	46.15	281.90	65.52	11.97	0.00	47.69	0.00	432.34	5.79
9. Consumption by energy sector	155.52	0.00	0.00	0.00	0.00	0.00	0.17	0.01	3.89	0.15	0.48	113.70	29.33	0.00	7.79	0.00
9.1.1 Crude petroleum and natural gas production	104.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.59	0.12	0.00	100.28	0.00	0.00	0.68	0.00
9.1.2 Natural gas w hich is flared off on oil fields	13.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.42	0.00	0.00	0.00	0.00
9.2. Coal mines	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.07	0.00
9.3. Petroleum refineries	31.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.03	0.48	0.00	29.33	0.00	1.84	0.00
9.4. Pumping storage pow er plants	2.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.05	0.00
9.5. Hydro electric pow er plants	3.25	0.00	0.00	0.00	0.00	0.00	0.16	0.01	0.13	0.00	0.00	0.00	0.00	0.00	2.95	0.00
9.6. Thermal pow er plants	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00
9.7. Combined heat and pow er plants	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00
9.8. District heating plants	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.08	0.00
9.9. Gas supply	33.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.77	0.00	28.71	1.76
10. Losses in transport and distribution																
11. Statistical differences (7-8+1.2-9-10-13.1)	2.17	1.64	-1.11	0.94	1.04	-9.18	4.17	-0.92	-5.19	-8.82	12.65	3.76	0.00	0.00	3.18	0.00
	2.17	1.64	-1.11	0.94	1.04	-9.18	4.17	-0.92	-5.19	-8.82	12.65	3.76	0.00	0.00	3.18	0.00
13.1 Net domestic consumption including non-energy use	740.57	20.75	12.26	13.92	35.26	0.00	74.28	18.71	131.90	11.98	39.03	0.00	15.53	0.00	362.93	4.03
13. Net domestic consumption	690.28	18.52	12.26	0.33	35.26	0.00	74.27	18.50	131.78	11.37	5.51	0.00	15.53	0.00	362.93	4.03
14. Manufacturing, mining and quarrying	255.33	18.33	12.21	0.33	14.65	0.00	0.00	0.05	13.73	10.67	5.30	0.00	15.46	0.00	163.75	0.85
14.1. Mining and quarrying	4.21	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.94	0.76	0.01	0.00	0.00	0.00	2.48	0.00
14.2. Manufacture of paper and paper products	38.53	0.21	0.00	0.00	9.78	0.00	0.00	0.00	0.14	2.95	0.01	0.00	0.00	0.00	25.44	0.00
14.3. Manufacture of industrial chemicals	46.92	4.49	1.74	0.00	0.00	0.00	0.00	0.00	0.62	1.55	2.65	0.00	14.39	0.00	21.03	0.47
14.4. Manufacture of iron, steel and ferro alloys	40.98	8.56	9.90	0.00	0.00	0.00	0.00	0.00	0.20	0.44	0.00	0.00	0.34	0.00	21.53	0.00
14.5. Manufacture of aluminium and other non-ferrous metals	64.19	0.00	0.31	0.00	0.00	0.00	0.00	0.00	1.52	0.82	0.36	0.00	0.73	0.00	60.45	0.00
14.6. Other manufacturing industries	60.50	5.08	0.26	0.33	4.87	0.00	0.00	0.03	10.31	4.16	2.27	0.00	0.00	0.00	32.81	0.38
15. Transport	159.82	0.00	0.00	0.00	0.00	0.00	73.32	9.68	74.08	0.52	0.00	0.00	0.00	0.00	2.21	0.00
15.1. Railw ays and subw ays	3.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.46	0.00	0.00	0.00	0.00	0.00	2.21	0.00
15.2. Air transport	9.79	0.00	0.00	0.00	0.00	0.00	0.11	9.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	114.93	0.00	0.00	0.00	0.00	0.00	71.49	0.00	43.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.4. Coastal shipping	31.43	0.00	0.00	0.00	0.00	0.00	1.72	0.00	29.18	0.52	0.00	0.00	0.00	0.00	0.00	0.00
16. Other sectors	275.14	0.19	0.04	0.00	20.61	0.00	0.95	8.77	43.97	0.17	0.21	0.00	0.07	0.00	196.98	3.18
16.1. Fishing	16.18	0.00	0.00	0.00	0.00	0.00	0.16	0.01	15.73	0.04	0.00	0.00	0.00	0.00	0.24	0.00
16.2. Agriculture	12.51	0.06	0.00	0.00	0.00	0.00	0.06	0.04	6.88	0.06	0.00	0.00	0.00	0.00	5.41	0.00
16.3. Households	153.27	0.12	0.04	0.00	20.61	0.00	0.72	6.12	6.42	0.02	0.14	0.00	0.00	0.00	118.03	1.04
16.4. Other consumers	88.35	0.00	0.00	0.00	0.00	0.00	0.00	2.57	11.55	0.05	0.07	0.00	0.07	0.00	71.90	2.14
16.5 Construction	4.83	0.00	0.00	0.00	0.00	0.00	0.01	0.02	3.40	0.00	0.00	0.00	0.00	0.00	1.40	0.00
12. Consumption for non-energy purposes	50.29	2.23	0.00	13.59	0.00	0.00	0.01	0.21	0.11	0.61	33.53	0.00	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	37.60	0.00	0.00	4.07	0.00	0.00	0.00	0.00	0.00	0.00	33.53	0.00	0.00	0.00	0.00	0.00
12.2 Other manufacturing	12.69	2.23	0.00	9.53	0.00	0.00	0.01	0.21	0.11	0.61	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**1994**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	7017.97	8.46	0.00	0.00	43.25	5250.83	88.94	0.00	0.00	0.00	105.42	1115.40	0.00	405.67	0.00	0.00
1.1.2 Production of natural gas that is flared off	14.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.00	0.00	0.00	0.00
2. Imports	249.43	22.35	15.44	11.80	0.09	44.62	25.72	6.06	21.33	39.38	45.25	0.00	0.00	0.00	17.41	0.00
3. Exports	6286.92	5.02	0.00	4.37	0.00	4709.50	177.55	17.80	179.69	52.93	102.42	1019.75	0.00	0.00	17.88	0.00
4.1 Bunkering	24.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.73	13.41	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	8.44	0.00	0.00	0.00	0.00	0.00	0.00	8.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-19.01	-0.12	0.23	-0.38	0.00	-10.76	3.33	0.01	-10.40	-1.20	0.29	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	943.20	25.67	15.67	7.06	43.34	575.18	-59.56	-20.17	-179.49	-28.16	48.53	109.95	0.00	405.67	-0.48	0.00
8. Energy converted	1048.31	0.80	1.60	0.00	5.83	593.15	6.41	2.55	2.05	28.55	0.56	0.00	0.12	405.67	1.02	0.00
8.1. In blast furnaces	1.60	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	633.22	0.00	0.00	0.00	0.00	593.15	6.41	2.55	2.00	28.55	0.56	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.25	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	2.96	0.80	0.00	0.00	2.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	3.62	0.00	0.00	0.00	2.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	1.02	0.00
8.6. In hydropow er plants	405.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	405.67	0.00	0.00
8.7. Other conversion																
1.2. Production of derived energy bearers	1077.42	0.00	0.00	7.15	0.00	0.00	182.08	50.44	294.30	70.23	14.28	0.00	45.58	0.00	407.57	5.80
9. Consumption by energy sector	170.05	0.00	0.00	0.00	0.00	0.00	0.13	0.00	5.29	0.09	0.80	123.95	28.74	0.00	11.04	0.00
9.1.1 Crude petroleum and natural gas production	115.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.98	0.06	0.00	109.66	0.00	0.00	1.01	0.00
9.1.2 Natural gas w hich is flared off on oil fields	14.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.00	0.00	0.00	0.00
9.2. Coal mines	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.08	0.00
9.3. Petroleum refineries	31.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.80	0.00	28.74	0.00	1.86	0.00
9.4. Pumping storage pow er plants	5.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.31	0.00
9.5. Hydro electric pow er plants	2.97	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.16	0.01	0.00	0.00	0.00	0.00	2.68	0.00
9.6. Thermal pow er plants	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
9.7. Combined heat and pow er plants	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00
9.8. District heating plants	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
9.9. Gas supply	32.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.90	0.00	28.36	1.58
10. Losses in transport and distribution																
11. Statistical differences (7-8+1.2-9-10-13.1)	9.33	0.92	0.80	-1.11	0.00	-17.96	41.86	5.12	-23.64	-4.14	21.28	-14.12	0.00	0.00	0.18	0.15
	9.33	0.92	0.80	-1.11	0.00	-17.96	41.86	5.12	-23.64	-4.14	21.28	-14.12	0.00	0.00	0.18	0.15
13.1 Net domestic consumption including non-energy use	760.09	23.95	13.27	15.31	37.51	0.00	74.11	22.60	131.11	17.56	40.17	0.12	13.82	0.00	366.49	4.07
13. Net domestic consumption	708.17	21.57	13.27	0.17	37.51	0.00	74.10	22.39	131.01	17.03	6.62	0.12	13.82	0.00	366.49	4.07
14. Manufacturing, mining and quarrying	268.39	21.39	13.23	0.17	15.50	0.00	0.00	0.05	15.64	16.40	6.39	0.11	13.74	0.00	164.48	1.27
14.1. Mining and quarrying	4.39	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.19	0.81	0.01	0.00	0.00	0.00	2.36	0.00
14.2. Manufacture of paper and paper products	41.62	0.32	0.00	0.00	10.53	0.00	0.00	0.00	0.29	7.45	0.08	0.00	0.00	0.00	22.95	0.00
14.3. Manufacture of industrial chemicals	46.69	5.01	1.55	0.00	0.00	0.00	0.00	0.00	0.75	2.48	3.06	0.01	12.67	0.00	20.83	0.32
14.4. Manufacture of iron, steel and ferro alloys	47.03	10.46	11.09	0.00	0.00	0.00	0.00	0.00	0.21	0.33	0.00	0.00	0.49	0.00	24.45	0.00
14.5. Manufacture of aluminium and other non-ferrous metals	65.41	0.00	0.29	0.00	0.00	0.00	0.00	0.01	1.56	0.90	0.36	0.10	0.58	0.00	61.61	0.00
14.6. Other manufacturing industries	63.25	5.60	0.30	0.17	4.98	0.00	0.00	0.02	11.64	4.42	2.88	0.00	0.00	0.00	32.28	0.95
15. Transport	156.22	0.00	0.00	0.00	0.00	0.00	73.16	10.84	69.68	0.36	0.00	0.00	0.00	0.00	2.18	0.00
15.1. Railw ays and subw ays	3.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.56	0.00	0.00	0.00	0.00	0.00	2.18	0.00
15.2. Air transport	10.95	0.00	0.00	0.00	0.00	0.00	0.11	10.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	111.89	0.00	0.00	0.00	0.00	0.00	71.33	0.00	40.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.4. Coastal shipping	29.64	0.00	0.00	0.00	0.00	0.00	1.72	0.00	27.56	0.36	0.00	0.00	0.00	0.00	0.00	0.00
16. Other sectors	283.56	0.18	0.04	0.00	22.00	0.00	0.94	11.50	45.68	0.27	0.22	0.00	0.07	0.00	199.84	2.80
16.1. Fishing	16.99	0.00	0.00	0.00	0.00	0.00	0.16	0.01	16.52	0.04	0.00	0.00	0.00	0.00	0.26	0.00
16.2. Agriculture	12.52	0.05	0.00	0.00	0.00	0.00	0.05	0.05	6.77	0.06	0.00	0.00	0.00	0.00	5.54	0.01
16.3. Households	158.72	0.12	0.04	0.00	22.00	0.00	0.72	6.63	5.67	0.01	0.14	0.00	0.00	0.00	122.45	0.94
16.4. Other consumers	89.67	0.00	0.00	0.00	0.00	0.00	0.00	4.79	12.68	0.16	0.09	0.00	0.07	0.00	70.02	1.86
16.5 Construction	5.67	0.00	0.00	0.00	0.00	0.00	0.01	0.03	4.05	0.00	0.00	0.00	0.00	0.00	1.57	0.00
12. Consumption for non-energy purposes	51.92	2.38	0.00	15.14	0.00	0.00	0.01	0.20	0.10	0.53	33.56	0.00	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	38.10	0.00	0.00	4.54	0.00	0.00	0.00	0.00	0.00	0.00	33.56	0.00	0.00	0.00	0.00	0.00
12.2 Other manufacturing	13.82	2.38	0.00	10.60	0.00	0.00	0.01	0.20	0.10	0.53	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**1995**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	7524.60	8.21	0.00	0.00	43.92	5635.74	113.55	0.00	0.00	0.00	125.71	1156.48	0.00	440.99	0.00	0.00
1.1.2 Production of natural gas that is flared off	15.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.85	0.00	0.00	0.00	0.00
2. Imports	260.12	26.13	14.87	14.23	0.09	59.50	34.68	4.01	28.20	27.47	42.66	0.00	0.00	0.00	8.28	0.00
3. Exports	6767.68	5.07	0.00	4.47	0.00	5154.68	183.68	14.16	154.11	53.05	127.92	1038.28	0.00	0.00	32.26	0.00
4.1 Bunkering	29.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.88	15.67	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	8.01	0.00	0.00	0.00	0.00	0.00	0.00	8.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-2.97	-0.67	-0.62	0.68	0.00	-9.65	-1.86	8.32	7.02	1.50	-7.70	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	992.36	28.60	14.25	10.43	44.00	530.91	-37.30	-9.84	-132.76	-39.75	32.76	134.05	0.00	440.99	-23.98	0.00
8. Energy converted	1034.59	0.83	1.54	0.16	6.22	541.86	8.66	3.01	9.10	20.18	0.54	0.00	0.11	440.99	1.38	0.00
8.1. In blast furnaces	1.54	0.00	1.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	583.19	0.00	0.00	0.16	0.00	541.86	8.66	3.01	8.79	20.18	0.54	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.35	0.00	0.00	0.00	1.30	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	3.17	0.83	0.00	0.00	2.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	4.35	0.00	0.00	0.00	2.58	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.11	0.00	1.38	0.00
8.6. In hydropow er plants	440.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	440.99	0.00	0.00
8.7. Other conversion																
1.2. Production of derived energy bearers	1051.76	0.00	0.00	5.80	0.00	0.00	160.79	45.65	266.67	71.91	13.58	0.00	38.57	0.00	442.84	5.95
9. Consumption by energy sector	167.43	0.00	0.00	0.00	0.00	0.00	0.14	0.00	5.35	0.09	0.00	126.70	25.11	0.00	10.03	0.00
9.1.1 Crude petroleum and natural gas production	117.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.06	0.06	0.00	110.85	0.00	0.00	1.06	0.00
9.1.2 Natural gas w hich is flared off on oil fields	15.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.85	0.00	0.00	0.00	0.00
9.2. Coal mines	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.09	0.00
9.3. Petroleum refineries	26.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00	25.11	0.00	1.76	0.00
9.4. Pumping storage pow er plants	4.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.92	0.00
9.5. Hydro electric pow er plants	2.35	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.11	0.00	0.00	0.00	0.00	0.00	2.11	0.00
9.6. Thermal pow er plants	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.8. District heating plants	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.05	0.00
9.9. Gas supply	30.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.54	0.00	26.15	1.54
10. Losses in transport and distribution																
11. Statistical differences (7-8+1.2-9-10-13.1)	40.42	1.20	-1.35	0.21	0.00	-10.95	41.56	10.06	-15.83	-2.60	3.83	6.56	0.00	0.00	7.74	0.00
	40.42	1.20	-1.35	0.21	0.00	-10.95	41.56	10.06	-15.83	-2.60	3.83	6.56	0.00	0.00	7.74	0.00
13.1 Net domestic consumption including non-energy use	771.44	26.57	14.06	15.86	37.78	0.00	73.13	22.75	135.29	14.48	41.97	0.79	10.80	0.00	373.56	4.41
13. Net domestic consumption	718.45	23.48	14.06	0.31	37.78	0.00	73.12	22.51	135.18	13.91	8.55	0.79	10.80	0.00	373.56	4.41
14. Manufacturing, mining and quarrying	272.79	23.34	14.02	0.31	16.22	0.00	0.00	0.06	14.86	13.30	7.76	0.78	10.67	0.00	170.01	1.45
14.1. Mining and quarrying	3.68	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.31	0.53	0.01	0.00	0.00	0.00	1.81	0.00
14.2. Manufacture of paper and paper products	42.85	0.29	0.00	0.00	11.13	0.00	0.00	0.00	0.33	6.14	0.15	0.00	0.00	0.00	24.81	0.00
14.3. Manufacture of industrial chemicals	45.09	5.18	1.66	0.00	0.00	0.00	0.00	0.00	0.82	1.70	3.87	0.17	9.52	0.00	21.89	0.29
14.4. Manufacture of iron, steel and ferro alloys	50.90	12.25	11.61	0.00	0.00	0.00	0.00	0.00	0.11	0.18	0.00	0.00	0.63	0.00	26.10	0.00
14.5. Manufacture of aluminium and other non-ferrous metals	65.96	0.00	0.36	0.00	0.00	0.00	0.00	0.01	1.44	0.87	0.32	0.54	0.52	0.00	61.90	0.00
14.6. Other manufacturing industries	64.31	5.62	0.38	0.31	5.10	0.00	0.00	0.03	10.85	3.88	3.42	0.07	0.00	0.00	33.49	1.16
15. Transport	161.06	0.00	0.00	0.00	0.00	0.00	72.17	11.67	74.40	0.51	0.00	0.00	0.00	0.00	2.31	0.00
15.1. Railw ays and subw ays	3.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.49	0.00	0.00	0.00	0.00	0.00	2.31	0.00
15.2. Air transport	11.77	0.00	0.00	0.00	0.00	0.00	0.10	11.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	114.93	0.00	0.00	0.00	0.00	0.00	70.35	0.00	44.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.4. Coastal shipping	30.57	0.00	0.00	0.00	0.00	0.00	1.72	0.00	28.34	0.51	0.00	0.00	0.00	0.00	0.00	0.00
16. Other sectors	284.60	0.14	0.04	0.00	21.56	0.00	0.95	10.78	45.92	0.11	0.78	0.00	0.12	0.00	201.24	2.96
16.1. Fishing	17.28	0.00	0.00	0.00	0.00	0.00	0.16	0.01	16.76	0.03	0.00	0.00	0.00	0.00	0.32	0.00
16.2. Agriculture	11.70	0.02	0.00	0.00	0.00	0.00	0.05	0.05	6.66	0.04	0.00	0.00	0.00	0.00	4.85	0.02
16.3. Households	160.69	0.12	0.04	0.00	21.44	0.00	0.72	6.39	6.13	0.01	0.14	0.00	0.00	0.00	124.66	1.04
16.4. Other consumers	88.52	0.00	0.00	0.00	0.00	0.00	0.00	4.29	12.27	0.02	0.10	0.00	0.12	0.00	69.81	1.89
16.5 Construction	6.42	0.00	0.00	0.00	0.11	0.00	0.01	0.05	4.10	0.00	0.54	0.00	0.00	0.00	1.61	0.00
12. Consumption for non-energy purposes	52.99	3.09	0.00	15.55	0.00	0.00	0.01	0.24	0.11	0.57	33.42	0.00	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	37.96	0.00	0.00	4.54	0.00	0.00	0.00	0.00	0.00	0.00	33.42	0.00	0.00	0.00	0.00	0.00
12.2 Other manufacturing	15.03	3.09	0.00	11.01	0.00	0.00	0.01	0.24	0.11	0.57	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**1996**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	8534.00	6.45	0.00	0.00	45.20	6322.88	133.69	0.00	0.00	0.00	137.42	1513.39	0.00	374.97	0.00	0.00
1.1.2 Production of natural gas that is flared off	18.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.16	0.00	0.00	0.00	0.00
2. Imports	290.86	23.38	17.01	12.96	0.09	56.38	21.41	5.49	25.93	40.18	40.47	0.00	0.00	0.00	47.56	0.00
3. Exports	7814.24	4.39	0.27	4.51	0.00	5786.63	221.79	19.24	151.78	59.93	137.66	1412.78	0.00	0.00	15.25	0.00
4.1 Bunkering	32.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.90	17.56	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	9.46	0.00	0.00	0.00	0.00	0.00	0.00	9.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-35.91	0.80	-0.92	-0.86	0.00	-27.19	-1.75	-7.59	-7.43	-0.60	9.62	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	950.94	26.25	15.82	7.60	45.29	565.43	-68.44	-30.80	-148.17	-37.92	49.85	118.76	0.00	374.97	32.31	0.00
8. Energy converted	1033.65	0.78	1.50	0.00	6.06	601.25	5.07	3.79	11.95	26.51	1.18	0.00	0.05	374.97	0.53	0.00
8.1. In blast furnaces	1.50	0.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	648.01	0.00	0.00	0.00	0.00	601.25	5.07	3.79	10.21	26.51	1.18	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.27	0.00	0.00	0.00	1.21	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	2.94	0.78	0.00	0.00	2.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	4.96	0.00	0.00	0.00	2.70	0.00	0.00	0.00	1.68	0.00	0.00	0.00	0.05	0.00	0.53	0.00
8.6. In hydropow er plants	374.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	374.97	0.00	0.00
8.7. Other conversion																
1.2. Production of derived energy bearers	1060.75	0.00	0.00	7.33	0.00	0.00	176.81	58.98	298.41	76.87	15.27	0.00	43.85	0.00	376.96	6.28
9. Consumption by energy sector	178.80	0.00	0.00	0.00	0.00	0.00	0.10	0.01	5.92	0.04	0.00	135.97	29.04	0.00	7.72	0.00
9.1.1 Crude petroleum and natural gas production	125.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.69	0.00	0.00	117.81	0.00	0.00	2.16	0.00
9.1.2 Natural gas w hich is flared off on oil fields	18.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.16	0.00	0.00	0.00	0.00
9.2. Coal mines	0.17	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.07	0.00
9.3. Petroleum refineries	30.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.00	0.00	29.04	0.00	1.80	0.00
9.4. Pumping storage pow er plants	1.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47	0.00
9.5. Hydro electric pow er plants	2.36	0.00	0.00	0.00	0.00	0.00	0.09	0.01	0.13	0.00	0.00	0.00	0.00	0.00	2.14	0.00
9.6. Thermal pow er plants	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.8. District heating plants	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.04	0.00
9.9. Gas supply																
10. Losses in transport and distribution	30.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.98	0.00	26.48	1.46
11. Statistical differences (7-8+1.2-9-10-13.1)	-27.86	-0.63	0.01	-0.67	0.00	-35.82	28.95	0.02	-20.21	-6.26	21.82	-18.29	0.00	0.00	3.22	0.00
	-27.86	-0.63	0.01	-0.67	0.00	-35.82	28.95	0.02	-20.21	-6.26	21.82	-18.29	0.00	0.00	3.22	0.00
13.1 Net domestic consumption including non-energy use	796.19	26.10	14.32	15.60	39.23	0.00	74.25	24.36	152.57	18.66	42.11	1.08	11.78	0.00	371.32	4.82
13. Net domestic consumption	743.28	23.48	14.32	0.24	39.23	0.00	74.24	24.13	152.45	18.04	8.17	1.08	11.78	0.00	371.32	4.82
14. Manufacturing, mining and quarrying	268.79	23.38	14.27	0.24	16.27	0.00	0.00	0.10	17.56	17.38	7.34	1.08	11.63	0.00	158.37	1.17
14.1. Mining and quarrying	3.60	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.96	0.59	0.00	0.00	0.00	0.00	2.03	0.00
14.2. Manufacture of paper and paper products	44.65	0.34	0.00	0.00	10.51	0.00	0.00	0.00	0.83	8.71	0.27	0.00	0.00	0.00	23.97	0.00
14.3. Manufacture of industrial chemicals	46.60	5.19	1.63	0.00	0.01	0.00	0.00	0.00	1.02	2.09	3.99	0.16	10.56	0.00	21.68	0.28
14.4. Manufacture of iron, steel and ferro alloys	49.69	12.31	11.92	0.00	0.00	0.00	0.00	0.00	0.25	0.34	0.00	0.00	0.40	0.00	24.46	0.00
14.5. Manufacture of aluminium and other non-ferrous metals	61.12	0.00	0.31	0.01	0.00	0.00	0.00	0.01	1.32	0.95	0.53	0.68	0.60	0.00	56.70	0.00
14.6. Other manufacturing industries	63.14	5.54	0.42	0.23	5.75	0.00	0.00	0.08	13.18	4.69	2.53	0.23	0.08	0.00	29.52	0.88
15. Transport	168.99	0.00	0.00	0.00	0.00	0.00	73.30	12.97	80.05	0.44	0.00	0.00	0.00	0.00	2.23	0.00
15.1. Railw ays and subw ays	3.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.08	0.00	0.00	0.00	0.00	0.00	2.23	0.00
15.2. Air transport	13.08	0.00	0.00	0.00	0.00	0.00	0.10	12.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	121.11	0.00	0.00	0.00	0.00	0.00	71.47	0.00	49.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.4. Coastal shipping	31.50	0.00	0.00	0.00	0.00	0.00	1.72	0.00	29.34	0.44	0.00	0.00	0.00	0.00	0.00	0.00
16. Other sectors	305.49	0.10	0.04	0.00	22.96	0.00	0.94	11.05	54.84	0.22	0.82	0.00	0.14	0.00	210.72	3.65
16.1. Fishing	19.25	0.00	0.00	0.00	0.00	0.00	0.16	0.01	18.66	0.10	0.00	0.00	0.00	0.00	0.32	0.00
16.2. Agriculture	11.63	0.01	0.00	0.00	0.00	0.00	0.04	0.06	7.20	0.11	0.00	0.00	0.00	0.00	4.17	0.03
16.3. Households	167.86	0.08	0.04	0.00	22.84	0.00	0.72	7.54	8.29	0.00	0.16	0.00	0.00	0.00	127.04	1.15
16.4. Other consumers	99.30	0.00	0.00	0.00	0.00	0.00	0.00	3.39	16.51	0.01	0.11	0.00	0.14	0.00	76.66	2.46
16.5 Construction	7.45	0.00	0.00	0.00	0.12	0.00	0.01	0.05	4.18	0.00	0.56	0.00	0.00	0.00	2.53	0.00
12. Consumption for non-energy purposes	52.91	2.62	0.00	15.36	0.00	0.00	0.01	0.24	0.12	0.62	33.95	0.00	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	38.76	0.00	0.00	4.82	0.00	0.00	0.00	0.00	0.00	0.00	33.95	0.00	0.00	0.00	0.00	0.00
12.2 Other manufacturing	14.15	2.62	0.00	10.54	0.00	0.00	0.01	0.23	0.12	0.62	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**1997**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	8811.32	10.86	0.00	0.00	47.55	6329.40	186.79	0.00	0.00	0.00	138.23	1699.12	0.00	399.38	0.00	0.00
1.1.2 Production of natural gas that is flared off	16.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.26	0.00	0.00	0.00	0.00
2. Imports	299.09	24.19	14.33	12.84	0.12	65.97	28.16	5.58	23.09	51.88	41.64	0.00	0.00	0.00	31.29	0.00
3. Exports	8059.25	5.16	0.12	3.22	0.00	5818.29	279.53	13.16	158.64	66.45	144.41	1552.73	0.00	0.00	17.55	0.00
4.1 Bunkering	39.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.94	19.48	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	10.55	0.00	0.00	0.00	0.00	0.00	0.00	10.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	0.91	-1.88	0.90	-0.34	0.00	13.99	0.52	-3.48	-5.31	-0.22	-3.26	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1018.36	28.01	15.11	9.28	47.67	591.09	-64.07	-21.61	-160.81	-34.27	32.19	162.65	0.00	399.38	13.75	0.00
8. Energy converted	1064.89	0.69	1.75	0.00	6.05	596.94	1.37	3.43	10.83	43.07	0.78	0.00	0.01	399.38	0.60	0.00
8.1. In blast furnaces	1.75	0.00	1.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	655.29	0.00	0.00	0.00	0.00	596.94	1.37	3.43	9.71	43.07	0.78	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.02	0.00	0.00	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	2.83	0.69	0.00	0.00	2.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants																
8.6. In hydropow er plants	4.62	0.00	0.00	0.00	2.90	0.00	0.00	0.00	1.11	0.00	0.00	0.00	0.01	0.00	0.60	0.00
8.7. Other conversion	399.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	399.38	0.00	0.00
1.2. Production of derived energy bearers	1086.58	0.00	0.00	6.89	0.00	0.00	177.25	45.75	309.45	76.77	16.51	0.00	46.42	0.00	401.11	6.43
9. Consumption by energy sector	188.37	0.00	0.00	0.00	0.00	0.00	0.09	0.00	6.65	0.04	0.00	138.03	30.17	0.00	13.38	0.00
9.1.1 Crude petroleum and natural gas production	131.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.40	0.00	0.00	121.77	0.00	0.00	3.34	0.00
9.1.2 Natural gas w hich is flared off on oil fields	16.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.26	0.00	0.00	0.00	0.00
9.2. Coal mines	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.04	0.00
9.3. Petroleum refineries	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	30.17	0.00	1.78	0.00
9.4. Pumping storage pow er plants	5.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.98	0.00
9.5. Hydro electric pow er plants	2.35	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.10	0.00	0.00	0.00	0.00	0.00	2.16	0.00
9.6. Thermal pow er plants	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.8. District heating plants	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.04	0.00
9.9. Gas supply																
10. Losses in transport and distribution	31.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	3.04	0.00	26.83	1.67
11. Statistical differences (7-8+1.2-9-10-13.1)	10.87	1.47	-0.90	0.25	0.00	-5.86	38.66	-3.38	-17.46	-17.69	4.47	11.28	0.01	0.00	0.02	0.00
	10.87	1.47	-0.90	0.25	0.00	-5.86	38.66	-3.38	-17.46	-17.69	4.47	11.28	0.01	0.00	0.02	0.00
13.1 Net domestic consumption including non-energy use	809.01	25.85	14.26	15.92	41.62	0.00	73.06	24.09	148.62	17.08	43.46	13.08	13.18	0.00	374.03	4.76
13. Net domestic consumption	745.13	22.92	14.26	0.24	41.62	0.00	73.05	23.80	148.49	16.43	7.45	4.90	13.18	0.00	374.03	4.76
14. Manufacturing, mining and quarrying	273.45	22.80	14.22	0.24	17.71	0.00	0.00	0.07	14.76	15.55	6.52	4.89	13.08	0.00	162.69	0.92
14.1. Mining and quarrying	2.92	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.90	0.24	0.00	0.00	0.00	0.00	1.75	0.00
14.2. Manufacture of paper and paper products	42.15	0.26	0.00	0.00	11.39	0.00	0.00	0.00	0.26	6.77	0.11	0.00	0.00	0.00	23.36	0.00
14.3. Manufacture of industrial chemicals	51.20	5.01	1.65	0.00	0.01	0.00	0.00	0.00	0.58	3.29	2.96	3.87	11.66	0.00	21.85	0.31
14.4. Manufacture of iron, steel and ferro alloys	48.47	11.47	11.84	0.00	0.00	0.00	0.00	0.00	0.20	0.18	0.01	0.00	0.64	0.00	24.13	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	65.80	0.00	0.34	0.01	0.00	0.00	0.00	0.01	1.11	0.58	0.96	0.64	0.64	0.00	61.48	0.02
14.6. Other manufacturing industries	62.90	6.06	0.39	0.23	6.31	0.00	0.00	0.04	11.71	4.49	2.47	0.38	0.14	0.00	30.11	0.58
15. Transport	171.91	0.00	0.00	0.00	0.00	0.00	72.10	13.33	83.52	0.76	0.00	0.01	0.00	0.00	2.20	0.00
15.1. Railw ays and subw ays	3.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11	0.00	0.00	0.00	0.00	0.00	2.20	0.00
15.2. Air transport	13.44	0.00	0.00	0.00	0.00	0.00	0.10	13.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	120.61	0.00	0.00	0.00	0.00	0.00	70.27	0.00	50.33	0.00	0.00	0.01	0.00	0.00	0.00	0.00
15.4. Coastal shipping	34.55	0.00	0.00	0.00	0.00	0.00	1.72	0.00	32.07	0.76	0.00	0.00	0.00	0.00	0.00	0.00
16. Other sectors	299.76	0.12	0.04	0.00	23.91	0.00	0.95	10.40	50.22	0.12	0.93	0.01	0.10	0.00	209.14	3.84
16.1. Fishing	20.29	0.00	0.00	0.00	0.00	0.00	0.18	0.01	19.67	0.02	0.00	0.00	0.00	0.00	0.41	0.00
16.2. Agriculture	10.46	0.02	0.00	0.00	0.00	0.00	0.04	0.05	6.29	0.09	0.00	0.00	0.00	0.00	3.91	0.06
16.3. Households	161.31	0.10	0.04	0.00	23.78	0.00	0.72	6.86	6.30	0.00	0.20	0.00	0.00	0.00	122.32	0.99
16.4. Other consumers	100.09	0.00	0.00	0.00	0.00	0.00	0.00	3.45	13.39	0.01	0.11	0.01	0.10	0.00	80.24	2.78
16.5 Construction	7.62	0.00	0.00	0.00	0.13	0.00	0.01	0.04	4.58	0.00	0.61	0.00	0.00	0.00	2.25	0.00
12. Consumption for non-energy purposes	63.88	2.93	0.00	15.68	0.00	0.00	0.01	0.29	0.13	0.65	36.01	8.18	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	48.78	0.00	0.00	4.59	0.00	0.00	0.00	0.00	0.00	0.00	36.01	8.18	0.00	0.00	0.00	0.00
12.2 Other manufacturing	15.10	2.93	0.00	11.09	0.00	0.00	0.01	0.29	0.13	0.65	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**1998**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	8561.89	9.22	0.00	0.00	44.44	6052.69	175.08	0.00	0.00	0.00	135.59	1726.22	0.00	418.65	0.00	0.00
1.1.2 Production of natural gas that is flared off	16.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.85	0.00	0.00	0.00	0.00
2. Imports	282.24	27.18	16.43	13.04	0.25	81.29	21.47	10.57	21.17	40.10	21.77	0.00	0.00	0.00	28.97	0.00
3. Exports	7742.44	8.19	0.30	3.01	0.00	5552.66	269.09	9.65	162.04	57.97	108.49	1555.15	0.00	0.00	15.88	0.00
4.1 Bunkering	37.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.75	17.00	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	11.24	0.00	0.00	0.00	0.00	0.00	0.00	11.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	25.81	0.52	-0.04	-0.40	0.00	23.20	0.88	1.27	-0.06	1.99	-1.57	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1095.37	28.74	16.10	9.63	44.69	604.53	-71.66	-9.05	-161.67	-32.88	47.29	187.92	0.00	418.65	13.08	0.00
8. Energy converted	1070.82	0.69	2.12	0.00	6.40	598.24	2.28	1.68	5.63	33.35	1.10	0.04	0.03	418.65	0.62	0.00
8.1. In blast furnaces	2.12	0.00	2.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	640.84	0.00	0.00	0.00	0.00	598.24	2.28	1.68	4.20	33.34	1.10	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.13	0.00	0.00	0.00	1.12	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	2.97	0.69	0.00	0.00	2.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	5.11	0.00	0.00	0.00	2.99	0.00	0.00	0.00	1.43	0.00	0.00	0.04	0.03	0.00	0.62	0.00
8.6. In hydropow er plants	418.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	418.65	0.00	0.00
8.7. Other conversion																
1.2. Production of derived energy bearers	1078.58	0.00	0.00	6.58	0.00	0.00	173.59	35.93	302.96	71.28	15.12	0.00	45.27	0.00	421.21	6.64
9. Consumption by energy sector	179.38	0.00	0.00	0.00	0.00	0.00	0.08	0.00	6.51	0.08	0.88	132.26	28.62	0.00	10.95	0.00
9.1.1 Crude petroleum and natural gas production	125.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.23	0.00	0.00	115.41	0.00	0.00	3.53	0.00
9.1.2 Natural gas w hich is flared off on oil fields	16.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.85	0.00	0.00	0.00	0.00
9.2. Coal mines	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.04	0.00
9.3. Petroleum refineries	31.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.88	0.00	28.62	0.00	1.86	0.00
9.4. Pumping storage pow er plants	2.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.97	0.00
9.5. Hydro electric pow er plants	2.63	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.07	0.04	0.00	0.00	0.00	0.00	2.44	0.00
9.6. Thermal pow er plants	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
9.7. Combined heat and pow er plants	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.8. District heating plants	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.06	0.00
9.9. Gas supply																
10. Losses in transport and distribution	33.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	3.48	0.00	27.95	1.55
11. Statistical differences (7-8+1.2-9-10-13.1)	51.20	-0.52	-0.96	2.07	0.00	6.29	25.70	2.19	-24.69	-12.49	19.86	33.75	0.00	0.00	0.00	0.00
	51.20	-0.52	-0.96	2.07	0.00	6.29	25.70	2.19	-24.69	-12.49	19.86	33.75	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	838.76	28.57	14.93	14.15	38.29	0.00	73.88	23.01	153.83	17.47	40.57	21.06	13.15	0.00	394.77	5.09
13. Net domestic consumption	771.17	24.53	14.93	0.27	38.29	0.00	73.86	22.73	153.70	16.82	7.23	5.80	13.15	0.00	394.77	5.09
14. Manufacturing, mining and quarrying	288.47	24.42	14.89	0.27	15.46	0.00	0.00	0.04	16.26	15.87	6.17	5.77	13.00	0.00	175.47	0.85
14.1. Mining and quarrying	3.30	0.00	0.00	0.00	0.00	0.00	0.00	0.01	1.26	0.19	0.00	0.00	0.00	0.00	1.84	0.00
14.2. Manufacture of paper and paper products	40.85	0.15	0.00	0.00	10.90	0.00	0.00	0.00	0.27	6.54	0.21	0.00	0.00	0.00	22.78	0.00
14.3. Manufacture of industrial chemicals	54.12	5.79	1.45	0.00	0.12	0.00	0.00	0.00	0.45	3.35	2.40	4.70	11.43	0.00	24.14	0.29
14.4. Manufacture of iron, steel and ferro alloys	54.35	12.82	12.55	0.00	0.00	0.00	0.00	0.00	0.29	0.09	0.01	0.00	0.75	0.00	27.82	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	72.02	0.00	0.44	0.00	0.00	0.00	0.00	0.01	1.25	0.54	0.84	0.55	0.67	0.00	67.71	0.02
14.6. Other manufacturing industries	63.82	5.65	0.44	0.27	4.44	0.00	0.00	0.03	12.74	5.15	2.71	0.51	0.16	0.00	31.19	0.53
15. Transport	175.33	0.00	0.00	0.00	0.00	0.00	72.92	13.66	85.71	0.73	0.00	0.01	0.00	0.00	2.30	0.00
15.1. Railw ays and subw ays	3.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	2.30	0.00
15.2. Air transport	13.76	0.00	0.00	0.00	0.00	0.00	0.10	13.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	120.79	0.00	0.00	0.00	0.00	0.00	71.10	0.00	49.68	0.00	0.00	0.01	0.00	0.00	0.00	0.00
15.4. Coastal shipping	37.59	0.00	0.00	0.00	0.00	0.00	1.72	0.00	35.14	0.73	0.00	0.00	0.00	0.00	0.00	0.00
16. Other sectors	307.37	0.11	0.04	0.00	22.84	0.00	0.94	9.02	51.73	0.22	1.05	0.02	0.15	0.00	217.00	4.24
16.1. Fishing	20.95	0.00	0.00	0.00	0.00	0.00	0.17	0.01	20.28	0.00	0.00	0.00	0.00	0.00	0.49	0.00
16.2. Agriculture	13.70	0.00	0.00	0.00	0.07	0.00	0.03	0.04	6.70	0.16	0.11	0.00	0.00	0.00	6.54	0.04
16.3. Households	164.44	0.11	0.04	0.00	22.63	0.00	0.72	6.27	7.21	0.04	0.17	0.00	0.00	0.00	126.17	1.07
16.4. Other consumers	100.51	0.00	0.00	0.00	0.00	0.00	0.00	2.66	12.66	0.02	0.12	0.02	0.15	0.00	81.75	3.13
16.5 Construction	7.77	0.00	0.00	0.00	0.14	0.00	0.01	0.05	4.88	0.00	0.65	0.00	0.00	0.00	2.05	0.00
12. Consumption for non-energy purposes	67.59	4.04	0.00	13.88	0.00	0.00	0.01	0.28	0.13	0.65	33.34	15.26	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	53.59	0.00	0.00	4.99	0.00	0.00	0.00	0.00	0.00	0.00	33.34	15.26	0.00	0.00	0.00	0.00
12.2 Other manufacturing	14.00	4.04	0.00	8.89	0.00	0.00	0.01	0.28	0.13	0.65	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**1999**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	8697.00	11.35	0.00	0.00	46.67	6000.62	181.31	0.00	0.00	0.00	161.76	1856.42	0.00	438.87	0.00	0.00
1.1.2 Production of natural gas that is flared off	24.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.73	0.00	0.00	0.00	0.00
2. Imports	283.76	25.70	14.94	13.70	0.44	88.83	17.82	12.15	16.76	47.21	21.54	0.00	0.00	0.00	24.68	0.00
3. Exports	7794.89	8.08	0.18	1.53	0.00	5435.82	288.52	8.61	150.20	66.51	108.85	1694.99	0.00	0.00	31.59	0.00
4.1 Bunkering	35.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.11	15.21	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	12.88	0.00	0.00	0.00	0.00	0.00	0.00	12.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-0.29	0.53	0.21	0.26	0.00	0.63	-7.63	-1.42	6.57	-1.06	1.62	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1162.11	29.49	14.97	12.43	47.10	654.26	-97.02	-10.77	-146.97	-35.58	76.07	186.16	0.00	438.87	-6.91	0.00
8. Energy converted	1108.39	0.70	1.70	0.00	6.66	606.55	4.63	2.86	2.98	41.82	1.09	0.10	0.04	438.87	0.41	0.00
8.1. In blast furnaces	1.70	0.00	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	658.05	0.00	0.00	0.00	0.00	606.55	4.63	2.86	1.13	41.81	1.09	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.35	0.00	0.00	0.00	1.27	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	3.08	0.70	0.00	0.00	2.37	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	5.33	0.00	0.00	0.00	3.03	0.00	0.00	0.00	1.76	0.00	0.00	0.10	0.04	0.00	0.41	0.00
8.6. In hydropow er plants	438.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	438.87	0.00	0.00
8.7. Other conversion																
1.2. Production of derived energy bearers	1131.21	0.00	0.00	7.25	0.00	0.00	183.63	34.36	321.03	74.42	14.82	0.00	46.37	0.00	442.20	7.13
9. Consumption by energy sector	181.23	0.00	0.00	0.00	0.00	0.00	0.06	0.00	6.91	0.07	0.99	130.87	30.13	0.00	12.18	0.02
9.1.1 Crude petroleum and natural gas production	117.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.72	0.00	0.00	106.13	0.00	0.00	4.44	0.00
9.1.2 Natural gas w hich is flared off on oil fields	24.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.73	0.00	0.00	0.00	0.00
9.2. Coal mines	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.02
9.3. Petroleum refineries	33.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.06	0.99	0.00	30.13	0.00	1.83	0.00
9.4. Pumping storage pow er plants	2.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.21	0.00
9.5. Hydro electric pow er plants	3.69	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.06	0.02	0.00	0.00	0.00	0.00	3.54	0.00
9.6. Thermal pow er plants	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.8. District heating plants	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.08	0.00
9.9. Gas supply																
10. Losses in transport and distribution	33.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68	3.95	0.00	26.84	1.55
11. Statistical differences (7-8+1.2-9-10-13.1)	125.56	1.28	0.01	5.25	0.00	47.71	8.53	-4.83	3.48	-18.45	51.98	30.59	0.00	0.00	0.00	0.00
	125.56	1.28	0.01	5.25	0.00	47.71	8.53	-4.83	3.48	-18.45	51.98	30.59	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	845.11	27.51	13.26	14.43	40.44	0.00	73.39	25.56	160.69	15.40	36.82	23.93	12.25	0.00	395.86	5.56
13. Net domestic consumption	779.55	24.81	13.26	0.43	40.44	0.00	73.38	25.27	160.57	14.78	5.78	7.17	12.25	0.00	395.86	5.56
14. Manufacturing, mining and quarrying	285.03	24.72	13.22	0.43	17.09	0.00	0.00	0.04	14.54	14.17	4.70	7.11	12.05	0.00	176.12	0.84
14.1. Mining and quarrying	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.23	0.17	0.00	0.00	0.00	0.00	1.60	0.00
14.2. Manufacture of paper and paper products	41.70	0.00	0.00	0.00	12.13	0.00	0.00	0.00	0.21	5.79	0.18	0.00	0.00	0.00	23.38	0.00
14.3. Manufacture of industrial chemicals	52.37	6.10	1.01	0.00	0.00	0.00	0.00	0.00	0.41	3.48	0.95	6.18	10.79	0.00	23.16	0.28
14.4. Manufacture of iron, steel and ferro alloys	53.34	13.40	11.37	0.00	0.00	0.00	0.00	0.00	0.35	0.02	0.04	0.00	0.62	0.00	27.55	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	72.40	0.06	0.45	0.00	0.00	0.00	0.00	0.00	1.14	0.92	0.80	0.54	0.51	0.00	67.97	0.00
14.6. Other manufacturing industries	62.21	5.15	0.39	0.43	4.96	0.00	0.00	0.04	11.20	3.79	2.73	0.39	0.13	0.00	32.45	0.55
15. Transport	183.79	0.00	0.00	0.00	0.00	0.00	72.44	15.70	93.01	0.50	0.00	0.01	0.00	0.00	2.12	0.00
15.1. Railw ays and subw ays	2.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.00	2.12	0.00
15.2. Air transport	15.81	0.00	0.00	0.00	0.00	0.00	0.11	15.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	123.83	0.00	0.00	0.00	0.00	0.00	70.60	0.00	53.21	0.00	0.00	0.01	0.00	0.00	0.00	0.00
15.4. Coastal shipping	41.18	0.00	0.00	0.00	0.00	0.00	1.72	0.00	38.95	0.50	0.00	0.00	0.00	0.00	0.00	0.00
16. Other sectors	310.73	0.09	0.04	0.00	23.35	0.00	0.94	9.54	53.02	0.10	1.08	0.05	0.19	0.00	217.62	4.72
16.1. Fishing	20.78	0.00	0.00	0.00	0.00	0.00	0.17	0.02	20.09	0.00	0.00	0.00	0.00	0.00	0.50	0.00
16.2. Agriculture	13.48	0.00	0.00	0.00	0.07	0.00	0.03	0.05	6.54	0.08	0.12	0.00	0.00	0.00	6.57	0.02
16.3. Households	165.33	0.08	0.04	0.00	23.14	0.00	0.72	6.20	7.63	0.00	0.18	0.00	0.00	0.00	126.17	1.17
16.4. Other consumers	103.41	0.00	0.00	0.00	0.00	0.00	0.00	3.23	13.91	0.02	0.13	0.05	0.19	0.00	82.35	3.53
16.5 Construction	7.73	0.00	0.00	0.00	0.14	0.00	0.01	0.04	4.85	0.00	0.65	0.00	0.00	0.00	2.03	0.00
12. Consumption for non-energy purposes	65.56	2.71	0.00	14.00	0.00	0.00	0.02	0.29	0.13	0.62	31.04	16.76	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	52.01	0.00	0.00	4.21	0.00	0.00	0.00	0.00	0.00	0.00	31.04	16.76	0.00	0.00	0.00	0.00
12.2 Other manufacturing	13.55	2.71	0.00	9.79	0.00	0.00	0.02	0.29	0.13	0.62	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2000**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	9321.99	17.76	0.00	0.00	45.76	6481.06	168.54	0.00	0.00	0.00	158.80	1937.72	0.00	512.35	0.00	0.00
1.1.2 Production of natural gas that is flared off	25.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.96	0.00	0.00	0.00	0.00
2. Imports	235.02	25.84	15.47	13.33	0.21	42.51	19.85	9.01	27.99	52.03	23.48	0.00	0.00	0.00	5.31	0.00
3. Exports	8244.60	16.12	0.07	0.87	0.00	5822.03	270.65	8.90	149.15	62.65	76.06	1764.21	0.00	0.00	73.90	0.00
4.1 Bunkering	34.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.83	14.51	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	12.49	0.00	0.00	0.00	0.00	0.00	0.00	12.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-27.67	0.62	0.53	0.85	0.00	-34.97	0.26	1.90	3.61	2.13	-2.60	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1263.87	28.09	15.94	13.31	45.97	666.57	-82.00	-10.48	-137.38	-23.00	103.62	199.48	0.00	512.35	-68.60	0.00
8. Energy converted	1189.60	0.65	1.88	0.00	6.55	580.25	32.48	1.11	1.09	39.93	11.66	0.10	0.04	512.35	1.51	0.00
8.1. In blast furnaces	1.88	0.00	1.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	655.58	0.00	0.00	0.00	0.00	580.25	32.48	1.11	0.31	39.91	1.52	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.29	0.00	0.00	0.00	1.17	0.00	0.00	0.00	0.11	0.01	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	3.04	0.65	0.00	0.00	2.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	5.34	0.00	0.00	0.00	2.99	0.00	0.00	0.00	0.67	0.01	0.01	0.10	0.04	0.00	1.51	0.00
8.6. In hydropow er plants	512.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	512.35	0.00	0.00
8.7. Other conversion	10.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.13	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1190.79	0.00	0.00	7.37	0.00	0.00	192.40	33.56	308.44	66.88	15.09	0.00	44.77	0.00	515.42	6.86
9. Consumption by energy sector	198.59	0.00	0.00	0.00	0.00	0.00	0.07	0.00	6.54	0.33	1.47	150.08	28.81	0.00	11.27	0.02
9.1.1 Crude petroleum and natural gas production	134.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.35	0.00	0.00	124.12	0.00	0.00	4.46	0.00
9.1.2 Natural gas w hich is flared off on oil fields	25.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.96	0.00	0.00	0.00	0.00
9.2. Coal mines	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.02	0.02
9.3. Petroleum refineries	32.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	1.47	0.00	28.81	0.00	1.84	0.00
9.4. Pumping storage pow er plants	2.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.42	0.00
9.5. Hydro electric pow er plants	2.58	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.07	0.00	0.00	0.00	0.00	0.00	2.43	0.00
9.6. Thermal pow er plants	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.8. District heating plants	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.07	0.00
9.9. Gas supply																
10. Losses in transport and distribution	42.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.34	3.49	0.00	36.27	1.47
11. Statistical differences (7-8+1.2-9-10-13.1)	201.25	0.30	-0.66	7.02	0.00	86.32	6.69	1.85	19.13	-8.08	65.57	23.12	0.00	0.00	0.00	0.00
	201.25	0.30	-0.66	7.02	0.00	86.32	6.69	1.85	19.13	-8.08	65.57	23.12	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	822.63	27.14	14.72	13.66	39.43	0.00	71.16	20.12	144.29	11.69	40.01	24.83	12.43	0.00	397.78	5.37
13. Net domestic consumption	755.80	24.20	14.72	0.42	39.43	0.00	71.14	19.85	144.17	11.08	7.83	7.38	12.43	0.00	397.78	5.37
14. Manufacturing, mining and quarrying	290.20	24.12	14.69	0.42	15.41	0.00	0.00	0.04	14.29	10.42	6.63	7.26	12.27	0.00	183.85	0.81
14.1. Mining and quarrying	3.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.28	0.20	0.00	0.00	0.00	0.00	1.82	0.00
14.2. Manufacture of paper and paper products	42.04	0.00	0.00	0.00	11.57	0.00	0.00	0.00	0.19	3.97	0.08	0.05	0.00	0.00	26.17	0.00
14.3. Manufacture of industrial chemicals	55.62	6.28	1.04	0.00	0.00	0.00	0.00	0.00	0.63	2.30	2.71	6.06	10.95	0.00	25.39	0.28
14.4. Manufacture of iron, steel and ferro alloys	55.10	13.12	12.77	0.00	0.00	0.00	0.00	0.00	0.49	0.03	0.07	0.00	0.61	0.00	27.99	0.02
14.5. Manufacture of aluminium and other non-ferrous metals	73.96	0.06	0.47	0.00	0.00	0.00	0.00	0.00	1.21	0.88	0.92	0.72	0.58	0.00	69.14	0.00
14.6. Other manufacturing industries	60.17	4.67	0.40	0.42	3.83	0.00	0.00	0.04	10.50	3.05	2.84	0.44	0.14	0.00	33.33	0.51
15. Transport	172.70	0.00	0.00	0.00	0.00	0.00	70.21	14.35	85.22	0.61	0.00	0.07	0.00	0.00	2.25	0.00
15.1. Railw ays and subw ays	2.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00	0.00	2.25	0.00
15.2. Air transport	14.46	0.00	0.00	0.00	0.00	0.00	0.11	14.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	118.49	0.00	0.00	0.00	0.00	0.00	68.37	0.00	50.09	0.00	0.00	0.02	0.00	0.00	0.00	0.00
15.4. Coastal shipping	36.78	0.00	0.00	0.00	0.00	0.00	1.72	0.00	34.40	0.61	0.00	0.05	0.00	0.00	0.00	0.00
16. Other sectors	292.90	0.08	0.03	0.00	24.02	0.00	0.93	5.46	44.66	0.05	1.21	0.05	0.16	0.00	211.68	4.56
16.1. Fishing	19.38	0.00	0.00	0.00	0.00	0.00	0.17	0.02	18.70	0.00	0.00	0.00	0.00	0.00	0.49	0.00
16.2. Agriculture	13.19	0.01	0.00	0.00	0.07	0.00	0.02	0.03	5.77	0.02	0.13	0.00	0.00	0.00	7.11	0.03
16.3. Households	160.04	0.07	0.03	0.00	23.81	0.00	0.72	4.72	4.87	0.00	0.29	0.00	0.00	0.00	124.66	0.86
16.4. Other consumers	92.54	0.00	0.00	0.00	0.00	0.00	0.00	0.67	10.53	0.03	0.13	0.04	0.16	0.00	77.29	3.67
16.5 Construction	7.75	0.00	0.00	0.00	0.14	0.00	0.01	0.02	4.79	0.00	0.65	0.00	0.00	0.00	2.13	0.00
12. Consumption for non-energy purposes	66.84	2.94	0.00	13.24	0.00	0.00	0.02	0.27	0.13	0.61	32.18	17.45	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	53.87	0.00	0.00	4.24	0.00	0.00	0.00	0.00	0.00	0.00	32.18	17.45	0.00	0.00	0.00	0.00
12.2 Other manufacturing	12.96	2.94	0.00	9.00	0.00	0.00	0.02	0.27	0.13	0.61	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2001**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	9523.79	50.24	0.00	0.00	48.63	6461.23	211.25	0.00	0.00	0.00	230.37	2086.28	0.00	435.79	0.00	0.00
1.1.2 Production of natural gas that is flared off	20.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.69	0.00	0.00	0.00	0.00
2. Imports	262.03	23.18	13.68	13.61	0.53	41.42	21.89	10.02	39.60	46.06	13.34	0.00	0.00	0.00	38.68	0.00
3. Exports	8597.60	42.08	0.05	0.35	0.00	6005.76	352.37	4.24	129.51	49.13	159.98	1828.31	0.00	0.00	25.83	0.00
4.1 Bunkering	34.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.76	14.46	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	11.43	0.00	0.00	0.00	0.00	0.00	0.00	11.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	66.21	-5.65	0.20	0.59	0.00	60.14	2.32	3.50	1.89	2.29	0.93	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1229.46	25.70	13.84	13.85	49.16	557.03	-116.91	-2.15	-107.78	-15.24	84.67	278.66	0.00	435.79	12.85	0.00
8. Energy converted	1075.26	0.72	1.32	0.00	7.07	538.32	30.48	0.74	3.82	41.61	13.14	0.08	0.03	435.79	2.14	0.01
8.1. In blast furnaces	1.32	0.00	1.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	615.68	0.00	0.00	0.00	0.00	538.32	30.48	0.74	2.75	41.61	1.77	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.51	0.00	0.00	0.00	1.23	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	2.88	0.72	0.00	0.00	2.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	6.75	0.00	0.00	0.00	3.67	0.00	0.00	0.00	0.78	0.00	0.03	0.08	0.03	0.00	2.14	0.01
8.6. In hydropow er plants	435.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	435.79	0.00	0.00
8.7. Other conversion	11.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.33	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1074.34	0.00	0.00	7.38	0.00	0.00	192.76	26.56	280.59	64.01	13.26	0.00	42.37	0.00	439.14	8.26
9. Consumption by energy sector	202.38	0.00	0.00	0.00	0.00	0.00	0.07	0.00	6.63	0.13	1.39	157.38	25.34	0.00	11.42	0.02
9.1.1 Crude petroleum and natural gas production	147.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.44	0.00	0.00	136.69	0.00	0.00	4.35	0.00
9.1.2 Natural gas w hich is flared off on oil fields	20.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.69	0.00	0.00	0.00	0.00
9.2. Coal mines	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.01
9.3. Petroleum refineries	28.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.13	1.39	0.00	25.34	0.00	1.55	0.00
9.4. Pumping storage pow er plants	2.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.90	0.00
9.5. Hydro electric pow er plants	2.54	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.06	0.00	0.00	0.00	0.00	0.00	2.41	0.00
9.6. Thermal pow er plants	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.8. District heating plants	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.11	0.01
9.9. Gas supply																
10. Losses in transport and distribution	41.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	3.69	0.00	35.88	1.48
11. Statistical differences (7-8+1.2-9-10-13.1)	126.34	0.96	-0.69	8.46	0.00	18.70	-28.51	2.44	12.70	-6.57	26.40	92.34	0.06	0.00	0.00	0.03
	126.33	0.96	-0.69	8.46	0.00	18.70	-28.51	2.44	12.70	-6.57	26.40	92.34	0.05	0.00	0.00	0.03
13.1 Net domestic consumption including non-energy use	858.27	24.02	13.21	12.77	42.10	0.00	73.82	21.23	149.67	13.59	56.99	28.35	13.25	0.00	402.55	6.73
13. Net domestic consumption	772.51	21.39	13.21	0.20	42.10	0.00	73.81	20.97	149.55	13.03	8.21	7.53	13.25	0.00	402.55	6.73
14. Manufacturing, mining and quarrying	281.05	21.34	13.17	0.20	17.03	0.00	0.00	0.03	13.71	12.63	6.98	7.16	12.97	0.00	175.07	0.76
14.1. Mining and quarrying	3.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.76	0.19	0.03	0.00	0.00	0.00	1.71	0.00
14.2. Manufacture of paper and paper products	42.35	0.00	0.00	0.00	12.88	0.00	0.00	0.00	0.31	5.81	0.07	0.41	0.00	0.00	22.89	0.00
14.3. Manufacture of industrial chemicals	54.93	5.76	1.19	0.00	0.00	0.00	0.00	0.00	0.60	2.28	3.16	5.28	11.95	0.00	24.43	0.28
14.4. Manufacture of iron, steel and ferro alloys	48.53	10.94	11.13	0.00	0.15	0.00	0.00	0.00	0.63	0.00	0.03	0.00	0.32	0.00	25.31	0.02
14.5. Manufacture of aluminium and other non-ferrous metals	73.57	0.06	0.46	0.00	0.00	0.00	0.00	0.00	0.88	0.88	0.83	1.06	0.63	0.00	68.77	0.00
14.6. Other manufacturing industries	57.99	4.58	0.38	0.20	4.00	0.00	0.00	0.03	9.54	3.49	2.87	0.41	0.07	0.00	31.96	0.46
15. Transport	176.20	0.00	0.00	0.00	0.00	0.00	72.86	14.44	86.26	0.25	0.00	0.10	0.00	0.00	2.29	0.00
15.1. Railw ays and subw ays	3.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	2.29	0.00
15.2. Air transport	14.55	0.00	0.00	0.00	0.00	0.00	0.11	14.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	126.37	0.00	0.00	0.00	0.00	0.00	71.03	0.00	55.29	0.00	0.00	0.05	0.00	0.00	0.00	0.00
15.4. Coastal shipping	32.28	0.00	0.00	0.00	0.00	0.00	1.72	0.00	30.25	0.25	0.00	0.05	0.00	0.00	0.00	0.00
16. Other sectors	315.26	0.05	0.04	0.00	25.07	0.00	0.95	6.50	49.58	0.14	1.23	0.27	0.28	0.00	225.19	5.97
16.1. Fishing	20.14	0.00	0.00	0.00	0.00	0.00	0.19	0.03	19.43	0.00	0.00	0.00	0.00	0.00	0.49	0.00
16.2. Agriculture	14.52	0.02	0.00	0.00	0.07	0.00	0.02	0.03	6.65	0.01	0.14	0.00	0.00	0.00	7.55	0.03
16.3. Households	167.76	0.03	0.04	0.00	24.86	0.00	0.72	5.25	6.15	0.00	0.31	0.09	0.00	0.00	129.15	1.17
16.4. Other consumers	104.33	0.00	0.00	0.00	0.00	0.00	0.00	1.17	12.64	0.13	0.14	0.18	0.28	0.00	85.02	4.76
16.5 Construction	8.51	0.00	0.00	0.00	0.14	0.00	0.01	0.02	4.71	0.00	0.64	0.00	0.00	0.00	2.98	0.00
12. Consumption for non-energy purposes	85.76	2.63	0.00	12.57	0.00	0.00	0.02	0.26	0.12	0.57	48.78	20.82	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	73.87	0.00	0.00	4.27	0.00	0.00	0.00	0.00	0.00	0.00	48.78	20.82	0.00	0.00	0.00	0.00
12.2 Other manufacturing	11.89	2.63	0.00	8.30	0.00	0.00	0.02	0.26	0.12	0.57	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2002**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	9785.49	59.90	0.00	0.00	50.51	6197.18	268.10	0.00	0.00	0.00	245.23	2496.88	0.00	467.68	0.00	0.00
1.1.2 Production of natural gas that is flared off	15.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.97	0.00	0.00	0.00	0.00
2. Imports	223.27	18.44	10.55	16.22	1.23	26.83	21.31	12.64	36.35	43.22	17.29	0.00	0.00	0.00	19.20	0.00
3. Exports	8876.79	57.64	0.00	1.82	0.00	5733.45	354.00	5.04	105.26	62.76	184.24	2318.40	0.00	0.00	54.17	0.00
4.1 Bunkering	27.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.00	9.45	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	10.12	0.00	0.00	0.00	0.00	0.00	0.00	10.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-2.10	2.27	0.54	-0.35	0.00	-4.53	-1.74	1.04	1.82	-2.18	1.04	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1108.28	22.97	11.08	14.05	51.73	486.02	-66.32	-1.49	-85.09	-31.17	79.32	194.45	0.00	467.68	-34.96	0.00
8. Energy converted	1070.49	0.69	1.20	0.00	7.07	501.55	37.41	1.69	5.19	32.36	13.82	0.08	0.02	467.68	1.73	0.01
8.1. In blast furnaces	1.20	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	578.96	0.00	0.00	0.00	0.00	501.55	37.41	1.69	3.57	32.25	2.48	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.27	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	3.09	0.69	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	6.98	0.00	0.00	0.00	3.68	0.00	0.00	0.00	1.33	0.11	0.03	0.08	0.02	0.00	1.72	0.01
8.6. In hydropow er plants	467.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	467.68	0.00	0.00
8.7. Other conversion	11.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.30	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1080.25	0.00	0.00	6.93	0.00	0.00	187.54	28.90	257.07	63.54	13.65	0.00	43.05	0.00	470.69	8.87
9. Consumption by energy sector	201.72	0.00	0.00	0.00	0.00	0.00	0.04	0.00	5.27	0.14	0.91	158.04	26.57	0.00	10.71	0.02
9.1.1 Crude petroleum and natural gas production	151.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.12	0.00	0.00	142.07	0.00	0.00	4.46	0.00
9.1.2 Natural gas w hich is flared off on oil fields	15.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.97	0.00	0.00	0.00	0.00
9.2. Coal mines	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.01
9.3. Petroleum refineries	29.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.14	0.91	0.00	26.57	0.00	1.53	0.00
9.4. Pumping storage pow er plants	2.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.39	0.00
9.5. Hydro electric pow er plants	2.21	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.06	0.00	0.00	0.00	0.00	0.00	2.10	0.00
9.6. Thermal pow er plants	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
9.7. Combined heat and pow er plants	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.05	0.00
9.8. District heating plants	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.06	0.01
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	38.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	3.26	0.00	33.62	1.60
11. Statistical differences (7-8+1.2-9-10-13.1)	38.35	0.99	-1.09	7.39	0.00	-15.53	10.42	3.44	9.45	-12.09	20.64	14.73	0.00	0.00	0.00	0.00
	38.35	0.99	-1.09	7.39	0.00	-15.53	10.42	3.44	9.45	-12.09	20.64	14.73	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	839.09	21.28	10.98	13.59	44.66	0.00	73.35	22.28	152.07	11.97	57.59	21.19	13.20	0.00	389.67	7.24
13. Net domestic consumption	757.06	18.75	10.98	0.21	44.66	0.00	73.35	22.28	151.58	11.05	8.33	5.77	13.20	0.00	389.67	7.24
14. Manufacturing, mining and quarrying	264.96	18.70	10.90	0.21	16.10	0.00	0.00	0.03	14.03	10.82	6.87	5.35	12.69	0.00	168.28	0.98
14.1. Mining and quarrying	3.59	0.00	0.00	0.00	0.01	0.00	0.00	0.02	1.71	0.20	0.03	0.01	0.00	0.00	1.62	0.00
14.2. Manufacture of paper and paper products	40.93	0.00	0.00	0.00	11.75	0.00	0.00	0.00	0.43	5.44	0.08	0.25	0.00	0.00	22.98	0.00
14.3. Manufacture of industrial chemicals	48.86	4.51	1.01	0.00	0.00	0.00	0.00	0.00	0.57	1.98	2.43	3.63	12.30	0.00	22.13	0.29
14.4. Manufacture of iron, steel and ferro alloys	42.79	9.61	9.38	0.00	0.19	0.00	0.00	0.00	0.60	0.01	0.09	0.00	0.23	0.00	22.66	0.02
14.5. Manufacture of aluminium and other non-ferrous metals	70.70	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.74	0.00	1.18	1.03	0.00	0.00	67.71	0.00
14.6. Other manufacturing industries	58.09	4.58	0.48	0.21	4.15	0.00	0.00	0.01	9.99	3.18	3.06	0.42	0.15	0.00	31.18	0.68
15. Transport	174.59	0.00	0.00	0.00	0.00	0.00	72.40	12.32	87.24	0.13	0.11	0.13	0.00	0.00	2.27	0.00
15.1. Railw ays and subw ays	2.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	2.27	0.00
15.2. Air transport	12.50	0.00	0.00	0.00	0.00	0.00	0.18	12.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	127.63	0.00	0.00	0.00	0.00	0.00	70.50	0.00	56.95	0.00	0.11	0.07	0.00	0.00	0.00	0.00
15.4. Coastal shipping	31.56	0.00	0.00	0.00	0.00	0.00	1.72	0.00	29.66	0.13	0.00	0.05	0.00	0.00	0.00	0.00
16. Other sectors	317.51	0.05	0.08	0.00	28.56	0.00	0.95	9.93	50.31	0.10	1.35	0.29	0.52	0.00	219.13	6.25
16.1. Fishing	21.02	0.00	0.00	0.00	0.00	0.00	0.20	0.02	20.28	0.04	0.00	0.00	0.00	0.00	0.49	0.00
16.2. Agriculture	13.46	0.00	0.00	0.00	0.07	0.00	0.02	0.03	6.00	0.04	0.15	0.00	0.00	0.00	7.13	0.03
16.3. Households	167.78	0.04	0.08	0.00	28.36	0.00	0.72	5.11	7.03	0.00	0.43	0.08	0.00	0.00	124.73	1.20
16.4. Other consumers	107.16	0.00	0.00	0.00	0.00	0.00	0.00	4.75	12.53	0.00	0.15	0.21	0.52	0.00	83.99	5.02
16.5 Construction	8.08	0.00	0.00	0.00	0.13	0.00	0.01	0.02	4.47	0.03	0.63	0.00	0.00	0.00	2.79	0.00
12. Consumption for non-energy purposes	82.02	2.54	0.00	13.39	0.00	0.00	0.00	0.00	0.49	0.92	49.26	15.43	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	68.20	0.00	0.00	3.21	0.00	0.00	0.00	0.00	0.30	0.00	49.26	15.43	0.00	0.00	0.00	0.00
12.2 Other manufacturing	13.82	2.54	0.00	10.17	0.00	0.00	0.00	0.00	0.19	0.92	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2003**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	9845.65	82.71	0.00	0.00	51.60	5905.06	366.38	0.00	0.00	0.00	271.86	2785.35	0.00	382.69	0.00	0.00
1.1.2 Production of natural gas that is flared off	16.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.21	0.00	0.00	0.00	0.00
2. Imports	259.68	18.89	10.88	12.79	2.37	26.40	17.57	12.33	33.45	58.33	18.35	0.00	0.00	0.00	48.32	0.00
3. Exports	8911.56	75.76	0.00	3.15	0.01	5372.46	478.37	4.38	117.25	73.35	198.78	2568.07	0.00	0.00	19.97	0.00
4.1 Bunkering	27.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.28	9.97	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	10.23	0.00	0.00	0.00	0.00	0.00	0.00	10.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-38.60	-2.98	-0.67	-0.12	0.00	-28.03	-0.20	-0.25	-2.58	0.84	-4.62	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1133.92	22.86	10.21	9.52	53.97	530.98	-94.62	-2.53	-103.66	-24.15	86.81	233.50	0.00	382.69	28.34	0.00
8. Energy converted	1054.00	0.57	1.14	0.00	8.99	560.17	36.49	1.08	5.89	41.67	14.10	0.27	0.01	382.69	0.91	0.01
8.1. In blast furnaces	1.14	0.00	1.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	645.05	0.00	0.00	0.00	0.00	560.17	36.49	1.08	3.30	41.56	2.45	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.64	0.00	0.00	0.00	1.24	0.00	0.00	0.00	0.37	0.00	0.00	0.02	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	4.08	0.57	0.00	0.00	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	7.89	0.00	0.00	0.00	4.24	0.00	0.00	0.00	2.22	0.11	0.14	0.25	0.01	0.00	0.91	0.01
8.6. In hydropow er plants	382.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	382.69	0.00	0.00
8.7. Other conversion	11.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.52	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1066.02	0.00	0.00	7.83	0.00	0.00	206.84	31.92	279.02	82.35	16.29	0.00	45.32	0.00	386.39	10.07
9. Consumption by energy sector	214.31	0.00	0.00	0.00	0.00	0.00	0.04	0.00	5.04	0.05	0.56	166.99	29.40	0.00	12.21	0.02
9.1.1 Crude petroleum and natural gas production	160.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.84	0.00	0.00	150.76	0.00	0.00	5.18	0.00
9.1.2 Natural gas w hich is flared off on oil fields	16.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.21	0.00	0.00	0.00	0.00
9.2. Coal mines	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
9.3. Petroleum refineries	32.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.05	0.56	0.00	29.40	0.00	1.95	0.00
9.4. Pumping storage pow er plants	3.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.11	0.00
9.5. Hydro electric pow er plants	1.76	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.06	0.00	0.00	0.00	0.00	0.00	1.66	0.00
9.6. Thermal pow er plants	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
9.7. Combined heat and pow er plants	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.08	0.00
9.8. District heating plants	0.10	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.01
9.9. Gas supply	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	33.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	2.32	0.00	28.62	2.24
11. Statistical differences (7-8+1.2-9-10-13.1)	58.48	1.61	-1.74	4.61	0.00	-29.19	3.17	8.65	6.58	0.34	27.89	36.57	0.00	0.00	0.00	0.00
	58.48	1.61	-1.74	4.61	0.00	-29.19	3.17	8.65	6.58	0.34	27.89	36.57	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	839.49	20.68	10.82	12.74	44.98	0.00	72.52	19.66	157.85	16.14	60.54	29.19	13.59	0.00	372.99	7.80
13. Net domestic consumption	749.84	18.44	10.82	0.17	44.98	0.00	72.52	19.66	157.36	15.22	8.67	7.63	13.59	0.00	372.99	7.80
14. Manufacturing, mining and quarrying	270.98	18.40	10.76	0.17	16.42	0.00	0.00	0.01	15.90	11.44	7.10	7.07	13.08	0.00	169.58	1.03
14.1. Mining and quarrying	3.81	0.00	0.00	0.00	0.00	0.00	0.00	0.01	1.88	0.20	0.05	0.01	0.00	0.00	1.66	0.00
14.2. Manufacture of paper and paper products	40.62	0.00	0.00	0.00	12.04	0.00	0.00	0.00	0.67	5.63	0.33	0.23	0.00	0.00	21.72	0.00
14.3. Manufacture of industrial chemicals	52.42	4.92	1.06	0.00	0.01	0.00	0.00	0.00	0.62	2.18	2.41	5.47	12.97	0.00	22.44	0.34
14.4. Manufacture of iron, steel and ferro alloys	39.79	8.69	9.24	0.00	0.20	0.00	0.00	0.00	0.81	0.02	0.07	0.00	0.06	0.00	20.68	0.02
14.5. Manufacture of aluminium and other non-ferrous metals	77.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.00	1.20	1.08	0.00	0.00	74.16	0.00
14.6. Other manufacturing industries	56.81	4.80	0.46	0.17	4.17	0.00	0.00	0.01	10.82	3.42	3.04	0.28	0.04	0.00	28.92	0.68
15. Transport	178.82	0.00	0.00	0.00	0.00	0.00	71.58	12.91	88.43	3.32	0.07	0.28	0.00	0.00	2.23	0.00
15.1. Railw ays and subw ays	2.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00	2.23	0.00
15.2. Air transport	13.06	0.00	0.00	0.00	0.00	0.00	0.15	12.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	130.62	0.00	0.00	0.00	0.00	0.00	69.71	0.00	60.73	0.00	0.07	0.10	0.00	0.00	0.00	0.00
15.4. Coastal shipping	32.31	0.00	0.00	0.00	0.00	0.00	1.72	0.00	27.09	3.32	0.00	0.18	0.00	0.00	0.00	0.00
16. Other sectors	300.03	0.04	0.05	0.00	28.55	0.00	0.93	6.73	53.03	0.46	1.50	0.28	0.51	0.00	201.18	6.77
16.1. Fishing	20.39	0.00	0.00	0.00	0.00	0.00	0.19	0.01	19.57	0.14	0.00	0.00	0.00	0.00	0.49	0.00
16.2. Agriculture	13.16	0.00	0.00	0.00	0.07	0.00	0.01	0.03	6.38	0.05	0.17	0.01	0.00	0.00	6.40	0.03
16.3. Households	159.71	0.03	0.05	0.00	28.18	0.00	0.72	5.88	7.58	0.00	0.55	0.08	0.00	0.00	115.28	1.35
16.4. Other consumers	99.29	0.00	0.00	0.00	0.17	0.00	0.00	0.79	15.17	0.26	0.15	0.19	0.51	0.00	76.64	5.39
16.5 Construction	7.49	0.00	0.00	0.00	0.13	0.00	0.01	0.02	4.32	0.01	0.62	0.00	0.00	0.00	2.37	0.00
12. Consumption for non-energy purposes	89.66	2.24	0.00	12.57	0.00	0.00	0.00	0.00	0.49	0.92	51.87	21.56	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	75.91	0.00	0.00	2.18	0.00	0.00	0.00	0.00	0.30	0.00	51.87	21.56	0.00	0.00	0.00	0.00
12.2 Other manufacturing	13.74	2.24	0.00	10.39	0.00	0.00	0.00	0.00	0.19	0.92	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2004**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	9905.26	81.61	0.00	0.00	50.60	5842.64	331.67	0.00	0.00	0.00	280.22	2924.18	0.00	394.35	0.00	0.00
1.1.2 Production of natural gas that is flared off	18.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.47	0.00	0.00	0.00	0.00
2. Imports	268.47	21.52	13.03	12.35	1.36	21.17	24.17	11.40	34.70	57.72	15.93	0.00	0.00	0.00	55.11	0.00
3. Exports	8907.26	77.03	0.01	0.65	0.01	5261.42	420.22	3.82	117.76	70.71	186.86	2754.90	0.00	0.00	13.87	0.00
4.1 Bunkering	26.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.83	10.21	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	11.59	0.00	0.00	0.00	0.00	0.00	0.00	11.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	15.23	-0.43	0.12	0.37	0.00	6.41	4.57	-0.81	2.81	0.64	1.54	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1262.54	25.68	13.15	12.07	51.94	608.80	-59.82	-4.82	-96.08	-22.55	110.83	187.74	0.00	394.35	41.24	0.00
8. Energy converted	1039.60	0.76	1.85	0.00	9.30	532.57	34.96	0.82	4.99	44.03	13.43	0.31	0.02	394.35	2.19	0.01
8.1. In blast furnaces	1.85	0.00	1.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	618.50	0.00	0.00	0.00	0.00	532.57	34.96	0.82	3.83	43.99	2.33	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.72	0.00	0.00	0.00	1.27	0.00	0.00	0.00	0.33	0.00	0.00	0.12	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	4.25	0.76	0.00	0.00	3.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	7.88	0.00	0.00	0.00	4.54	0.00	0.00	0.00	0.84	0.04	0.06	0.19	0.02	0.00	2.19	0.01
8.6. In hydropow er plants	394.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	394.35	0.00	0.00
8.7. Other conversion	11.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.04	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1057.21	0.00	0.00	6.05	0.00	0.00	202.91	28.88	272.80	78.16	15.41	0.00	44.07	0.00	398.33	10.61
9. Consumption by energy sector	222.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	5.26	0.07	0.50	175.98	27.71	0.00	12.43	0.02
9.1.1 Crude petroleum and natural gas production	168.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.08	0.00	0.00	157.47	0.00	0.00	5.67	0.00
9.1.2 Natural gas w hich is flared off on oil fields	18.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.47	0.00	0.00	0.00	0.00
9.2. Coal mines	0.14	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
9.3. Petroleum refineries	30.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.07	0.50	0.00	27.71	0.00	1.89	0.00
9.4. Pumping storage pow er plants	2.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.62	0.00
9.5. Hydro electric pow er plants	2.04	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.06	0.00	0.00	0.00	0.00	0.00	1.94	0.00
9.6. Thermal pow er plants	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.09	0.00
9.8. District heating plants	0.10	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.08	0.01
9.9. Gas supply	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	39.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	2.72	0.00	33.60	2.19
11. Statistical differences (7-8+1.2-9-10-13.1)	166.47	1.90	-1.26	5.82	0.00	76.23	35.96	2.41	11.10	-4.19	61.27	-22.76	0.00	0.00	0.00	0.00
	166.47	1.90	-1.26	5.82	0.00	76.23	35.96	2.41	11.10	-4.19	61.27	-22.76	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	852.68	23.01	12.57	12.30	42.65	0.00	72.13	20.83	155.37	15.70	51.04	33.72	13.62	0.00	391.35	8.40
13. Net domestic consumption	770.52	20.71	12.57	0.06	42.65	0.00	72.13	20.83	154.88	14.78	9.64	8.92	13.62	0.00	391.35	8.40
14. Manufacturing, mining and quarrying	285.51	20.65	12.55	0.06	15.70	0.00	0.00	0.01	13.31	10.76	7.90	7.93	13.13	0.00	182.48	1.03
14.1. Mining and quarrying	4.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.21	0.13	0.03	0.10	0.04	0.00	1.71	0.00
14.2. Manufacture of paper and paper products	41.00	0.00	0.00	0.00	11.30	0.00	0.00	0.00	0.51	5.76	0.25	0.38	0.00	0.00	22.80	0.00
14.3. Manufacture of industrial chemicals	54.28	5.88	1.09	0.00	0.01	0.00	0.00	0.00	0.49	1.91	3.46	5.32	12.46	0.00	23.33	0.32
14.4. Manufacture of iron, steel and ferro alloys	47.06	10.75	10.94	0.00	0.21	0.00	0.00	0.00	0.49	0.00	0.06	0.04	0.45	0.00	24.09	0.02
14.5. Manufacture of aluminium and other non-ferrous metals	83.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00	1.04	1.14	0.00	0.00	80.70	0.00
14.6. Other manufacturing industries	55.35	4.02	0.51	0.06	4.18	0.00	0.00	0.01	8.89	2.95	3.05	0.97	0.18	0.00	29.84	0.69
15. Transport	183.88	0.00	0.00	0.00	0.00	0.00	71.19	12.76	93.77	3.57	0.08	0.38	0.00	0.00	2.13	0.00
15.1. Railw ays and subw ays	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.00	0.00	0.00	2.13	0.00
15.2. Air transport	12.94	0.00	0.00	0.00	0.00	0.00	0.18	12.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	135.46	0.00	0.00	0.00	0.00	0.00	69.29	0.00	65.99	0.00	0.08	0.10	0.00	0.00	0.00	0.00
15.4. Coastal shipping	32.72	0.00	0.00	0.00	0.00	0.00	1.72	0.00	27.14	3.57	0.00	0.28	0.00	0.00	0.00	0.00
16. Other sectors	301.13	0.06	0.02	0.00	26.94	0.00	0.94	8.06	47.79	0.45	1.66	0.61	0.49	0.00	206.74	7.37
16.1. Fishing	19.94	0.00	0.00	0.00	0.00	0.00	0.19	0.00	19.08	0.18	0.00	0.00	0.00	0.00	0.49	0.00
16.2. Agriculture	13.94	0.00	0.00	0.00	0.07	0.00	0.01	0.03	6.28	0.06	0.18	0.24	0.00	0.00	7.05	0.01
16.3. Households	156.68	0.06	0.02	0.00	26.49	0.00	0.72	5.02	5.47	0.00	0.62	0.12	0.00	0.00	116.66	1.50
16.4. Other consumers	103.25	0.00	0.00	0.00	0.24	0.00	0.00	2.99	12.46	0.19	0.21	0.25	0.49	0.00	80.57	5.85
16.5 Construction	7.31	0.00	0.00	0.00	0.14	0.00	0.01	0.02	4.51	0.02	0.65	0.00	0.00	0.00	1.98	0.00
12. Consumption for non-energy purposes	82.16	2.30	0.00	12.25	0.00	0.00	0.00	0.00	0.49	0.92	41.40	24.80	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	68.15	0.00	0.00	1.65	0.00	0.00	0.00	0.00	0.30	0.00	41.40	24.80	0.00	0.00	0.00	0.00
12.2 Other manufacturing	14.01	2.30	0.00	10.59	0.00	0.00	0.00	0.00	0.19	0.92	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2005**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	9674.92	41.33	0.00	0.00	54.99	5319.74	340.48	0.00	0.00	0.00	289.58	3135.78	0.00	493.02	0.00	0.00
1.1.2 Production of natural gas that is flared off	16.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.91	0.00	0.00	0.00	0.00
2. Imports	235.99	18.75	10.88	12.64	0.88	45.19	22.01	7.02	24.93	69.28	11.26	0.00	0.00	0.00	13.15	0.00
3. Exports	8642.39	46.81	0.07	0.23	0.01	4730.04	430.83	6.57	106.05	70.16	223.77	2971.34	0.00	0.00	56.50	0.00
4.1 Bunkering	29.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.66	12.24	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	14.78	0.00	0.00	0.00	0.00	0.00	0.00	14.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-18.21	9.07	-0.67	-0.17	0.00	-16.67	-3.05	0.20	-4.76	-1.75	-0.41	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1222.54	22.34	10.14	12.23	55.86	618.21	-71.38	-14.12	-103.54	-14.88	76.66	181.35	0.00	493.02	-43.35	0.00
8. Energy converted	1200.18	0.71	1.46	0.00	9.47	565.35	53.55	0.36	5.46	55.16	12.52	0.54	0.03	493.02	2.52	0.02
8.1. In blast furnaces	1.46	0.00	1.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	680.83	0.00	0.00	0.00	0.00	565.35	53.55	0.36	4.63	55.16	1.78	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.96	0.00	0.00	0.00	1.41	0.00	0.00	0.00	0.29	0.00	0.00	0.25	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	4.15	0.71	0.00	0.00	3.43	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	8.05	0.00	0.00	0.00	4.62	0.00	0.00	0.00	0.53	0.00	0.03	0.29	0.03	0.00	2.52	0.02
8.6. In hydropow er plants	493.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	493.02	0.00	0.00
8.7. Other conversion	10.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.71	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1221.08	0.00	0.00	7.92	0.00	0.00	239.25	34.32	299.24	68.84	17.71	0.00	45.92	0.00	496.82	11.07
9. Consumption by energy sector	222.98	0.00	0.00	0.00	0.00	0.00	0.07	0.00	4.76	0.00	0.00	170.99	30.82	0.00	16.34	0.01
9.1.1 Crude petroleum and natural gas production	166.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.55	0.00	0.00	154.02	0.00	0.00	7.92	0.00
9.1.2 Natural gas w hich is flared off on oil fields	16.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.91	0.00	0.00	0.00	0.00
9.2. Coal mines	0.13	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
9.3. Petroleum refineries	32.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	30.82	0.00	2.02	0.00
9.4. Pumping storage pow er plants	3.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.93	0.00
9.5. Hydro electric pow er plants	2.26	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.07	0.00	0.00	0.00	0.00	0.00	2.15	0.00
9.6. Thermal pow er plants	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.12	0.00
9.8. District heating plants	0.11	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.08	0.01
9.9. Gas supply	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	40.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	1.84	0.00	35.98	2.21
11. Statistical differences (7-8+1.2-9-10-13.1)	129.33	2.08	-2.16	6.78	0.00	52.85	44.78	1.72	29.24	-15.48	31.03	-21.52	0.00	0.00	0.00	0.00
	129.33	2.08	-2.16	6.78	0.00	52.85	44.78	1.72	29.24	-15.48	31.03	-21.52	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	850.76	19.55	10.83	13.37	46.39	0.00	69.48	18.12	156.25	14.28	50.82	31.00	13.23	0.00	398.62	8.83
13. Net domestic consumption	769.72	17.18	10.83	0.05	46.39	0.00	69.48	18.12	155.75	13.36	8.66	9.23	13.23	0.00	398.62	8.83
14. Manufacturing, mining and quarrying	281.21	17.17	10.80	0.05	17.61	0.00	0.00	0.03	12.17	10.49	6.87	7.67	12.53	0.00	184.75	1.08
14.1. Mining and quarrying	4.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01	2.03	0.06	0.06	0.18	0.06	0.00	1.64	0.00
14.2. Manufacture of paper and paper products	40.82	0.00	0.00	0.00	11.81	0.00	0.00	0.00	0.22	5.31	0.15	0.30	0.00	0.00	23.03	0.00
14.3. Manufacture of industrial chemicals	53.40	5.20	1.03	0.00	0.47	0.00	0.00	0.00	0.48	2.28	2.42	4.14	12.02	0.00	25.01	0.33
14.4. Manufacture of iron, steel and ferro alloys	38.48	8.70	9.27	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.02	0.07	0.31	0.00	19.61	0.03
14.5. Manufacture of aluminium and other non-ferrous metals	88.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.99	1.65	0.00	0.00	85.53	0.01
14.6. Other manufacturing industries	55.77	3.27	0.51	0.05	5.33	0.00	0.00	0.02	8.43	2.83	3.23	1.33	0.13	0.00	29.93	0.70
15. Transport	184.59	0.00	0.00	0.00	0.00	0.00	68.54	10.78	100.31	2.32	0.08	0.41	0.00	0.00	2.16	0.00
15.1. Railw ays and subw ays	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00	2.16	0.00
15.2. Air transport	10.88	0.00	0.00	0.00	0.00	0.00	0.10	10.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	135.95	0.00	0.00	0.00	0.00	0.00	66.71	0.00	69.09	0.00	0.08	0.07	0.00	0.00	0.00	0.00
15.4. Coastal shipping	34.98	0.00	0.00	0.00	0.00	0.00	1.72	0.00	30.60	2.32	0.00	0.34	0.00	0.00	0.00	0.00
16. Other sectors	303.92	0.01	0.03	0.00	28.78	0.00	0.94	7.32	43.28	0.54	1.71	1.16	0.70	0.00	211.71	7.75
16.1. Fishing	19.19	0.00	0.00	0.00	0.00	0.00	0.19	0.00	18.27	0.16	0.00	0.00	0.00	0.00	0.56	0.00
16.2. Agriculture	14.43	0.00	0.00	0.00	0.07	0.00	0.01	0.02	6.26	0.05	0.20	0.66	0.00	0.00	7.15	0.00
16.3. Households	162.27	0.01	0.03	0.00	28.35	0.00	0.72	4.29	4.07	0.00	0.62	0.22	0.00	0.00	122.42	1.54
16.4. Other consumers	99.89	0.00	0.00	0.00	0.22	0.00	0.00	2.98	9.94	0.32	0.21	0.27	0.70	0.00	79.04	6.21
16.5 Construction	8.15	0.00	0.00	0.00	0.14	0.00	0.01	0.01	4.74	0.00	0.68	0.01	0.00	0.00	2.55	0.00
12. Consumption for non-energy purposes	81.04	2.37	0.00	13.32	0.00	0.00	0.00	0.00	0.49	0.92	42.16	21.77	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	65.96	0.00	0.00	1.73	0.00	0.00	0.00	0.00	0.30	0.00	42.16	21.77	0.00	0.00	0.00	0.00
12.2 Other manufacturing	15.08	2.37	0.00	11.60	0.00	0.00	0.00	0.00	0.19	0.92	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2006**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	9323.01	67.30	0.00	0.00	52.84	4935.95	351.80	0.00	0.00	0.00	266.52	3215.28	0.00	433.31	0.00	0.00
1.1.2 Production of natural gas that is flared off	15.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.60	0.00	0.00	0.00	0.00
2. Imports	240.32	14.85	11.15	13.27	1.56	16.24	14.92	10.48	39.56	71.86	11.15	0.00	0.00	0.00	35.29	0.00
3. Exports	8274.30	63.68	0.00	0.35	0.06	4231.47	439.42	10.27	127.65	88.49	245.70	3035.00	0.00	0.00	32.21	0.00
4.1 Bunkering	29.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.88	12.98	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	17.02	0.00	0.00	0.00	0.00	0.00	0.00	17.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-17.80	-0.56	0.82	0.37	0.00	-11.82	-2.84	0.36	-2.38	2.03	-3.77	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1239.95	17.91	11.96	13.28	54.34	708.91	-75.55	-16.46	-107.35	-27.58	28.20	195.88	0.00	433.31	3.08	0.00
8. Energy converted	1181.21	0.69	1.83	0.00	9.84	598.64	56.97	0.23	4.96	56.82	14.93	0.74	0.02	433.31	2.22	0.00
8.1. In blast furnaces	1.83	0.00	1.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	717.87	0.00	0.00	0.00	0.00	598.64	56.97	0.23	3.83	56.82	1.36	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	1.96	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.34	0.00	0.00	0.29	0.00	0.00	0.00	0.00
8.4. In dual purpose pow er plants	4.11	0.69	0.00	0.00	3.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	8.70	0.00	0.00	0.00	5.08	0.00	0.00	0.00	0.79	0.00	0.14	0.44	0.02	0.00	2.22	0.00
8.6. In hydropow er plants	433.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	433.31	0.00	0.00
8.7. Other conversion	13.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.43	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1203.15	0.00	0.00	7.39	0.00	0.00	246.26	38.00	310.21	82.73	19.18	0.00	50.13	0.00	437.54	11.71
9. Consumption by energy sector	226.60	0.00	0.00	0.00	0.00	0.00	0.06	0.00	5.40	0.00	0.00	174.15	31.55	0.00	15.43	0.02
9.1.1 Crude petroleum and natural gas production	173.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.24	0.00	0.00	158.54	0.00	0.00	9.51	0.00
9.1.2 Natural gas w hich is flared off on oil fields	15.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.60	0.00	0.00	0.00	0.00
9.2. Coal mines	0.15	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
9.3. Petroleum refineries	33.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	31.55	0.00	1.78	0.00
9.4. Pumping storage pow er plants	1.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.85	0.00
9.5. Hydro electric pow er plants	2.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.04	0.00	0.00	0.00	0.00	0.00	1.94	0.00
9.6. Thermal pow er plants	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.09	0.00
9.8. District heating plants	0.15	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.12	0.02
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	41.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	2.07	0.00	36.26	2.27
11. Statistical differences (7-8+1.2-9-10-13.1)	146.77	0.61	0.68	6.36	0.00	110.27	46.85	2.60	27.45	-18.25	-18.14	-11.65	0.00	0.00	0.00	0.00
	146.77	0.61	0.68	6.36	0.00	110.27	46.85	2.60	27.45	-18.25	-18.14	-11.65	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	847.51	16.61	9.46	14.31	44.50	0.00	66.84	18.71	165.06	16.58	50.58	32.24	16.49	0.00	386.70	9.42
13. Net domestic consumption	766.21	14.55	9.46	0.06	44.50	0.00	66.84	18.71	164.56	15.66	9.30	9.95	16.49	0.00	386.70	9.42
14. Manufacturing, mining and quarrying	274.81	14.53	9.45	0.06	17.19	0.00	0.00	0.02	12.70	11.14	7.44	8.24	15.86	0.00	177.12	1.08
14.1. Mining and quarrying	4.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.17	0.06	0.06	0.19	0.13	0.00	1.61	0.00
14.2. Manufacture of paper and paper products	39.03	0.00	0.00	0.00	11.38	0.00	0.00	0.00	0.22	6.01	0.20	0.34	0.00	0.00	20.87	0.00
14.3. Manufacture of industrial chemicals	53.93	3.20	0.92	0.00	0.47	0.00	0.00	0.00	0.38	2.14	2.55	4.16	15.14	0.00	24.66	0.32
14.4. Manufacture of iron, steel and ferro alloys	31.25	7.72	8.01	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.01	0.10	0.42	0.00	14.57	0.04
14.5. Manufacture of aluminium and other non-ferrous metals	88.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	1.02	1.91	0.00	0.00	85.00	0.02
14.6. Other manufacturing industries	58.03	3.61	0.52	0.06	5.34	0.00	0.00	0.01	9.13	2.94	3.60	1.54	0.18	0.00	30.41	0.69
15. Transport	193.04	0.00	0.00	0.00	0.21	0.00	65.90	11.69	108.68	3.70	0.08	0.44	0.00	0.00	2.34	0.00
15.1. Railw ays and subw ays	2.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.00	0.00	2.34	0.00
15.2. Air transport	11.77	0.00	0.00	0.00	0.00	0.00	0.08	11.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	142.48	0.00	0.00	0.00	0.21	0.00	64.09	0.00	77.98	0.00	0.08	0.11	0.00	0.00	0.00	0.00
15.4. Coastal shipping	35.86	0.00	0.00	0.00	0.00	0.00	1.72	0.00	30.10	3.70	0.00	0.33	0.00	0.00	0.00	0.00
16. Other sectors	298.36	0.02	0.02	0.00	27.10	0.00	0.94	7.00	43.19	0.82	1.78	1.27	0.63	0.00	207.25	8.35
16.1. Fishing	18.12	0.00	0.00	0.00	0.00	0.00	0.19	0.00	17.09	0.29	0.00	0.00	0.00	0.00	0.54	0.00
16.2. Agriculture	14.05	0.00	0.00	0.00	0.07	0.00	0.01	0.02	6.13	0.08	0.24	0.66	0.00	0.00	6.84	0.01
16.3. Households	159.75	0.01	0.02	0.00	26.55	0.00	0.72	4.29	4.47	0.00	0.62	0.14	0.00	0.00	121.13	1.81
16.4. Other consumers	98.09	0.00	0.00	0.00	0.33	0.00	0.00	2.67	10.61	0.45	0.21	0.47	0.63	0.00	76.17	6.54
16.5 Construction	8.35	0.00	0.00	0.00	0.15	0.00	0.01	0.01	4.89	0.00	0.70	0.01	0.00	0.00	2.57	0.00
12. Consumption for non-energy purposes	81.30	2.06	0.00	14.25	0.00	0.00	0.00	0.00	0.49	0.92	41.28	22.29	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	64.96	0.00	0.00	1.09	0.00	0.00	0.00	0.00	0.30	0.00	41.28	22.29	0.00	0.00	0.00	0.00
12.2 Other manufacturing	16.34	2.06	0.00	13.17	0.00	0.00	0.00	0.00	0.19	0.92	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2007**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	8997.74	114.46	0.00	0.00	53.93	4603.83	181.02	0.00	0.00	0.00	285.50	3270.73	0.00	488.26	0.00	0.00
1.1.2 Production of natural gas that is flared off	37.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.44	0.00	0.00	0.00	0.00
2. Imports	256.89	17.14	12.59	12.68	2.64	61.20	15.20	8.42	35.48	67.58	4.92	0.00	0.00	0.00	19.02	0.00
3. Exports	8131.44	94.72	0.00	1.24	0.03	4116.98	340.02	9.54	120.84	88.63	238.82	3065.47	0.00	0.00	55.15	0.00
4.1 Bunkering	27.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.51	10.95	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	15.85	0.00	0.00	0.00	0.00	0.00	0.00	15.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	19.86	-15.61	-0.14	0.13	0.00	36.90	0.00	-0.90	-0.28	-0.93	0.68	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1137.19	21.27	12.46	11.58	56.54	584.96	-143.80	-17.86	-102.15	-32.93	52.29	242.70	0.00	488.26	-36.13	0.00
8. Energy converted	1235.76	0.75	2.19	0.00	10.75	602.47	48.01	2.02	6.46	53.90	12.43	5.28	0.59	488.26	2.64	0.00
8.1. In blast furnaces	2.19	0.00	2.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	713.10	0.00	0.00	0.00	0.00	602.47	48.01	2.02	5.45	53.90	1.24	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	7.11	0.00	0.00	0.00	1.60	0.00	0.00	0.00	0.17	0.00	0.00	4.77	0.57	0.00	0.00	0.00
8.4. In dual purpose pow er plants	4.58	0.75	0.00	0.00	3.82	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5. In district heating plants	9.43	0.00	0.00	0.00	5.33	0.00	0.00	0.00	0.83	0.00	0.09	0.51	0.02	0.00	2.64	0.00
8.6. In hydropow er plants	488.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	488.26	0.00	0.00
8.7. Other conversion	11.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.10	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1253.37	0.00	0.00	7.30	0.00	0.00	248.57	36.55	300.77	87.28	19.33	0.00	46.88	0.00	493.79	12.89
9. Consumption by energy sector	255.40	0.00	0.00	0.00	0.00	0.00	0.04	0.00	7.44	0.00	0.00	196.93	30.55	0.00	20.40	0.04
9.1.1 Crude petroleum and natural gas production	176.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.90	0.00	0.00	159.49	0.00	0.00	10.53	0.00
9.1.2 Natural gas w hich is flared off on oil fields	37.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.44	0.00	0.00	0.00	0.00
9.2. Coal mines	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.15	0.00
9.3. Petroleum refineries	32.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	30.55	0.00	2.09	0.00
9.4. Pumping storage pow er plants	5.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.55	0.00
9.5. Hydro electric pow er plants	2.05	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.12	0.00	0.00	0.00	0.00	0.00	1.90	0.00
9.6. Thermal pow er plants	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.09	0.00
9.8. District heating plants	0.13	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.07	0.04
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	42.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	2.91	0.00	36.28	2.46
11. Statistical differences (7-8+1.2-9-10-13.1)	-6.30	2.31	-0.20	5.43	0.00	-17.51	-6.68	-2.31	14.52	-14.67	2.23	10.57	0.00	0.00	0.00	0.00
	-6.30	2.31	-0.20	5.43	0.00	-17.51	-6.68	-2.31	14.52	-14.67	2.23	10.57	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	863.09	18.21	10.47	13.45	45.79	0.00	63.40	18.97	170.20	15.11	56.95	28.97	12.84	0.00	398.34	10.39
13. Net domestic consumption	780.12	15.83	10.47	0.30	45.79	0.00	63.40	18.97	169.70	14.20	9.17	10.72	12.84	0.00	398.34	10.39
14. Manufacturing, mining and quarrying	268.00	15.82	10.42	0.30	17.87	0.00	0.00	0.02	10.94	8.69	7.16	7.54	12.09	0.00	176.03	1.12
14.1. Mining and quarrying	4.23	0.00	0.00	0.00	0.00	0.00	0.00	0.02	2.20	0.05	0.04	0.18	0.06	0.00	1.68	0.00
14.2. Manufacture of paper and paper products	37.92	0.00	0.00	0.00	12.02	0.00	0.00	0.00	0.20	4.40	0.12	0.16	0.03	0.00	20.99	0.00
14.3. Manufacture of industrial chemicals	52.71	5.34	2.59	0.00	0.77	0.00	0.00	0.00	0.44	1.60	2.32	2.97	11.42	0.00	24.82	0.44
14.4. Manufacture of iron, steel and ferro alloys	32.27	6.87	7.24	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.04	0.07	0.40	0.00	17.26	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	85.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.01	1.04	2.12	0.00	0.00	82.14	0.06
14.6. Other manufacturing industries	55.09	3.61	0.59	0.30	5.08	0.00	0.00	0.00	7.29	2.64	3.61	2.04	0.18	0.00	29.14	0.61
15. Transport	203.08	0.00	0.00	0.00	1.19	0.00	62.44	13.59	116.97	4.83	0.08	1.69	0.00	0.00	2.29	0.00
15.1. Railw ays and subw ays	2.91	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00	2.29	0.00
15.2. Air transport	13.66	0.00	0.00	0.00	0.00	0.00	0.07	13.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	148.34	0.00	0.00	0.00	1.18	0.00	60.65	0.00	86.32	0.00	0.08	0.11	0.00	0.00	0.00	0.00
15.4. Coastal shipping	38.18	0.00	0.00	0.00	0.00	0.00	1.72	0.00	30.04	4.83	0.00	1.59	0.00	0.00	0.00	0.00
16. Other sectors	309.04	0.01	0.06	0.00	26.73	0.00	0.96	5.36	41.79	0.67	1.92	1.49	0.74	0.00	220.02	9.27
16.1. Fishing	17.48	0.00	0.00	0.00	0.00	0.00	0.21	0.00	16.57	0.18	0.00	0.00	0.00	0.00	0.53	0.00
16.2. Agriculture	14.03	0.00	0.00	0.00	0.05	0.00	0.01	0.02	6.04	0.07	0.24	0.61	0.00	0.00	6.97	0.01
16.3. Households	162.53	0.01	0.01	0.00	26.09	0.00	0.72	3.35	3.81	0.00	0.54	0.15	0.00	0.00	125.81	2.05
16.4. Other consumers	105.71	0.00	0.05	0.00	0.40	0.00	0.01	1.98	9.89	0.41	0.33	0.71	0.74	0.00	83.97	7.21
16.5 Construction	9.28	0.00	0.00	0.00	0.20	0.00	0.02	0.01	5.49	0.01	0.81	0.01	0.00	0.00	2.74	0.00
12. Consumption for non-energy purposes	82.97	2.38	0.00	13.15	0.00	0.00	0.00	0.00	0.49	0.92	47.78	18.25	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	65.53	0.00	0.00	1.03	0.00	0.00	0.00	0.00	0.25	0.00	46.00	18.25	0.00	0.00	0.00	0.00
12.2 Other manufacturing	17.44	2.38	0.00	12.11	0.00	0.00	0.00	0.00	0.25	0.92	1.78	0.00	0.00	0.00	0.00	0.00

Energy balance	**2008**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	9184.29	96.39	0.00	0.00	54.80	4383.35	211.12	0.00	0.00	0.00	279.59	3651.82	0.00	507.22	0.00	0.00
1.1.2 Production of natural gas that is flared off	33.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.21	0.00	0.00	0.00	0.00
2. Imports	240.27	18.10	12.98	17.47	4.71	35.05	19.57	10.89	40.70	60.26	8.24	0.00	0.00	0.00	12.28	0.00
3. Exports	8162.64	94.10	0.00	0.25	0.02	3770.69	310.50	12.06	105.11	110.87	258.83	3438.01	0.00	0.00	62.19	0.00
4.1 Bunkering	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.17	11.32	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	15.74	0.00	0.00	0.00	0.00	0.00	0.00	15.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-15.63	2.85	-0.20	-0.32	0.00	-16.58	-0.63	-1.13	0.65	-1.11	0.85	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1236.27	23.24	12.78	16.90	59.49	631.14	-80.45	-18.04	-79.93	-63.04	29.85	247.03	0.00	507.22	-49.91	0.00
8. Energy converted	1200.02	0.63	2.02	0.00	11.62	551.10	44.19	0.34	16.50	47.40	12.75	3.17	0.65	507.22	2.42	0.01
8.1. In blast furnaces	2.02	0.00	2.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	660.15	0.00	0.00	0.00	0.00	551.10	44.19	0.34	15.81	47.40	1.30	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	4.85	0.00	0.00	0.00	1.63	0.00	0.00	0.00	0.09	0.00	0.00	2.51	0.63	0.00	0.00	0.00
8.4. In dual purpose pow er plants	4.83	0.63	0.00	0.00	4.15	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.01	0.00
8.5. In district heating plants	9.69	0.00	0.00	0.00	5.85	0.00	0.00	0.00	0.54	0.00	0.19	0.67	0.02	0.00	2.41	0.01
8.6. In hydropow er plants	507.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	507.22	0.00	0.00
8.7. Other conversion	11.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.26	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1218.15	0.00	0.00	6.29	0.00	0.00	207.99	39.85	279.35	99.50	16.31	0.00	43.60	0.00	511.59	13.68
9. Consumption by energy sector	256.41	0.00	0.00	0.00	0.00	0.00	0.04	0.00	7.51	0.00	0.00	200.74	26.93	0.00	21.15	0.04
9.1.1 Crude petroleum and natural gas production	186.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.87	0.00	0.00	167.53	0.00	0.00	11.72	0.00
9.1.2 Natural gas w hich is flared off on oil fields	33.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.21	0.00	0.00	0.00	0.00
9.2. Coal mines	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.14	0.00
9.3. Petroleum refineries	28.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	26.93	0.00	1.90	0.00
9.4. Pumping storage pow er plants	4.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.82	0.00
9.5. Hydro electric pow er plants	2.26	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.05	0.00	0.00	0.00	0.00	0.00	2.19	0.00
9.6. Thermal pow er plants	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and pow er plants	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.09	0.00
9.8. District heating plants	0.33	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.04
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	40.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	2.97	0.00	34.84	2.62
11. Statistical differences (7-8+1.2-9-10-13.1)	89.25	3.61	0.22	2.90	0.00	80.04	23.91	3.31	10.02	-25.32	-16.42	6.98	0.00	0.00	0.00	0.00
	89.25	3.61	0.22	2.90	0.00	80.04	23.91	3.31	10.02	-25.32	-16.42	6.98	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	867.86	19.01	10.54	20.29	47.86	0.00	59.40	18.16	165.39	14.37	49.83	35.68	13.05	0.00	403.28	11.02
13. Net domestic consumption	780.81	16.55	10.54	0.39	47.86	0.00	59.40	18.15	164.90	13.45	9.79	12.43	13.05	0.00	403.28	11.02
14. Manufacturing, mining and quarrying	272.61	16.54	10.48	0.39	18.01	0.00	0.00	0.07	10.52	8.04	7.67	8.77	12.35	0.00	178.62	1.14
14.1. Mining and quarrying	4.96	0.00	0.00	0.00	0.00	0.00	0.00	0.03	2.72	0.06	0.04	0.19	0.13	0.00	1.79	0.01
14.2. Manufacture of paper and paper products	36.93	0.00	0.00	0.00	12.77	0.00	0.00	0.00	0.15	4.03	0.11	0.12	0.14	0.00	19.61	0.00
14.3. Manufacture of industrial chemicals	55.87	5.80	2.63	0.00	0.58	0.00	0.00	0.00	0.38	1.19	2.55	3.50	11.63	0.00	27.07	0.54
14.4. Manufacture of iron, steel and ferro alloys	33.63	7.39	7.30	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.05	0.07	0.31	0.00	18.02	0.00
14.5. Manufacture of aluminium and other non-ferrous metals	86.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	1.03	2.01	0.00	0.00	82.55	0.05
14.6. Other manufacturing industries	55.09	3.35	0.55	0.39	4.66	0.00	0.00	0.05	6.32	2.75	3.89	2.87	0.14	0.00	29.58	0.54
15. Transport	198.00	0.00	0.00	0.00	3.30	0.00	58.44	14.12	112.91	4.68	0.08	2.01	0.00	0.00	2.46	0.00
15.1. Railw ays and subw ays	3.08	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00	2.46	0.00
15.2. Air transport	14.20	0.00	0.00	0.00	0.00	0.00	0.08	14.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	146.24	0.00	0.00	0.00	3.28	0.00	56.64	0.00	86.10	0.00	0.08	0.14	0.00	0.00	0.00	0.00
15.4. Coastal shipping	34.48	0.00	0.00	0.00	0.00	0.00	1.72	0.00	26.20	4.68	0.00	1.87	0.00	0.00	0.00	0.00
16. Other sectors	310.21	0.01	0.06	0.00	26.55	0.00	0.96	3.96	41.46	0.74	2.04	1.65	0.70	0.00	222.20	9.88
16.1. Fishing	17.19	0.00	0.00	0.00	0.00	0.00	0.21	0.00	16.16	0.14	0.00	0.04	0.00	0.00	0.64	0.00
16.2. Agriculture	14.00	0.00	0.00	0.00	0.05	0.00	0.01	0.01	5.92	0.04	0.27	0.63	0.00	0.00	7.05	0.01
16.3. Households	161.29	0.01	0.01	0.00	25.92	0.00	0.72	2.42	3.29	0.05	0.55	0.13	0.00	0.00	125.60	2.59
16.4. Other consumers	107.31	0.00	0.05	0.00	0.33	0.00	0.01	1.51	10.53	0.50	0.38	0.83	0.70	0.00	85.17	7.28
16.5 Construction	10.43	0.00	0.00	0.00	0.25	0.00	0.02	0.01	5.56	0.00	0.83	0.02	0.00	0.00	3.74	0.00
12. Consumption for non-energy purposes	87.04	2.45	0.00	19.89	0.00	0.00	0.00	0.00	0.49	0.92	40.04	23.25	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	62.98	0.00	0.00	1.23	0.00	0.00	0.00	0.00	0.25	0.00	38.26	23.25	0.00	0.00	0.00	0.00
12.2 Other manufacturing	24.06	2.45	0.00	18.66	0.00	0.00	0.00	0.00	0.25	0.92	1.78	0.00	0.00	0.00	0.00	0.00

Energy balance	**2009**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	9047.59	74.20	0.00	0.00	53.71	4146.54	237.54	0.00	0.00	0.00	274.08	3804.12	0.00	457.39	0.00	0.00
1.1.2 Production of natural gas that is flared off	17.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.98	0.00	0.00	0.00	0.00
2. Imports	280.26	11.83	7.94	13.30	4.96	51.84	16.55	8.65	73.58	59.29	12.00	0.00	0.00	0.00	20.34	0.00
3. Exports	8187.11	67.35	0.00	0.05	0.07	3645.00	366.74	6.00	97.92	84.55	269.18	3597.57	0.00	0.00	52.68	0.00
4.1 Bunkering	23.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.35	8.94	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	14.96	0.00	0.00	0.00	0.00	0.00	0.00	14.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	23.95	-3.64	0.43	0.34	0.00	22.80	-0.32	0.38	2.17	-1.30	3.09	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1144.40	15.04	8.37	13.58	58.60	576.17	-112.97	-11.93	-36.52	-35.51	19.99	224.53	0.00	457.39	-32.34	0.00
8. Energy converted	1175.65	0.74	1.50	0.00	11.98	547.70	46.48	1.08	14.97	54.82	11.57	23.72	0.55	457.39	3.12	0.02
8.1. In blast furnaces	1.50	0.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	665.01	0.00	0.00	0.00	0.00	547.70	46.48	1.08	13.73	54.82	1.19	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	24.66	0.00	0.00	0.00	0.86	0.00	0.00	0.00	0.14	0.00	0.00	23.15	0.52	0.00	0.00	0.00
8.4. In dual purpose pow er plants	5.66	0.74	0.00	0.00	4.76	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.07	0.00
8.5. In district heating plants	11.38	0.00	0.00	0.00	6.36	0.00	0.00	0.00	1.00	0.00	0.34	0.57	0.03	0.00	3.06	0.02
8.6. In hydropow er plants	457.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	457.39	0.00	0.00
8.7. Other conversion	10.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.04	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1188.68	0.00	0.00	5.30	0.00	0.00	232.31	34.52	278.90	85.22	19.83	0.00	42.53	0.00	474.38	15.70
9. Consumption by energy sector	240.11	0.00	0.00	0.00	0.00	0.00	0.02	0.01	8.75	0.00	0.14	177.71	27.95	0.00	25.49	0.03
9.1.1 Crude petroleum and natural gas production	184.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.31	0.00	0.00	159.73	0.00	0.00	16.78	0.00
9.1.2 Natural gas w hich is flared off on oil fields	17.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.98	0.00	0.00	0.00	0.00
9.2. Coal mines	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.14	0.00
9.3. Petroleum refineries	30.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.14	0.00	27.95	0.00	2.06	0.00
9.4. Pumping storage pow er plants	4.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.09	0.00
9.5. Hydro electric pow er plants	2.31	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.05	0.00	0.00	0.00	0.00	0.00	2.24	0.00
9.6. Thermal pow er plants	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.08	0.00
9.7. Combined heat and pow er plants	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.05	0.00
9.8. District heating plants	0.08	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.03
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	37.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	2.72	0.00	31.06	3.22
11. Statistical differences (7-8+1.2-9-10-13.1)	54.40	0.31	-0.01	2.98	0.00	28.47	17.07	3.17	49.22	-17.81	-19.63	-9.39	0.00	0.00	0.00	0.00
	54.40	0.31	-0.01	2.98	0.00	28.47	17.07	3.17	49.22	-17.81	-19.63	-9.39	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	825.23	14.00	6.88	15.89	46.62	0.00	55.76	18.32	169.43	12.71	47.73	31.80	11.30	0.00	382.36	12.43
13. Net domestic consumption	749.25	12.31	6.88	0.34	46.62	0.00	55.76	18.32	168.94	11.79	9.00	13.21	11.30	0.00	382.36	12.43
14. Manufacturing, mining and quarrying	223.91	12.30	6.87	0.29	15.14	0.00	0.00	0.05	8.84	7.31	6.94	9.24	10.89	0.00	144.77	1.28
14.1. Mining and quarrying	3.72	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.86	0.03	0.04	0.15	0.03	0.00	1.57	0.01
14.2. Manufacture of paper and paper products	30.62	0.00	0.00	0.00	9.68	0.00	0.00	0.00	0.39	3.65	0.13	0.03	0.12	0.00	16.62	0.00
14.3. Manufacture of industrial chemicals	48.25	3.80	1.45	0.00	0.52	0.00	0.00	0.00	0.63	1.23	3.00	4.50	10.33	0.00	22.32	0.47
14.4. Manufacture of iron, steel and ferro alloys	23.49	5.06	4.95	0.00	0.03	0.00	0.00	0.00	0.47	0.00	0.04	0.05	0.24	0.00	12.64	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	71.88	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.32	0.00	0.88	1.87	0.00	0.00	68.71	0.03
14.6. Other manufacturing industries	45.95	3.44	0.46	0.20	4.91	0.00	0.00	0.03	5.18	2.40	2.85	2.64	0.17	0.00	22.91	0.77
15. Transport	197.20	0.00	0.00	0.00	3.90	0.00	54.77	14.57	115.51	3.87	0.08	2.14	0.00	0.00	2.37	0.00
15.1. Railw ays and subw ays	2.99	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	2.37	0.00
15.2. Air transport	14.65	0.00	0.00	0.00	0.00	0.00	0.08	14.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	144.38	0.00	0.00	0.00	3.87	0.00	52.97	0.00	87.31	0.00	0.08	0.14	0.00	0.00	0.00	0.00
15.4. Coastal shipping	35.19	0.00	0.00	0.00	0.00	0.00	1.72	0.00	27.60	3.87	0.00	1.99	0.00	0.00	0.00	0.00
16. Other sectors	328.14	0.01	0.01	0.04	27.58	0.00	0.99	3.70	44.60	0.61	1.98	1.83	0.41	0.00	235.23	11.16
16.1. Fishing	19.63	0.00	0.00	0.00	0.00	0.00	0.22	0.01	18.57	0.11	0.00	0.00	0.00	0.00	0.72	0.00
16.2. Agriculture	13.85	0.00	0.00	0.00	0.15	0.00	0.01	0.01	5.75	0.00	0.28	0.69	0.00	0.00	6.96	0.02
16.3. Households	167.24	0.01	0.01	0.00	26.64	0.00	0.72	2.16	3.58	0.01	0.54	0.15	0.00	0.00	130.73	2.70
16.4. Other consumers	116.99	0.00	0.00	0.04	0.54	0.00	0.03	1.51	11.23	0.50	0.37	0.96	0.41	0.00	92.96	8.44
16.5 Construction	10.43	0.00	0.00	0.00	0.25	0.00	0.02	0.01	5.47	0.00	0.79	0.04	0.00	0.00	3.86	0.00
12. Consumption for non-energy purposes	75.98	1.69	0.00	15.55	0.00	0.00	0.00	0.00	0.49	0.92	38.73	18.59	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	56.56	0.00	0.00	0.78	0.00	0.00	0.00	0.00	0.25	0.00	36.95	18.59	0.00	0.00	0.00	0.00
12.2 Other manufacturing	19.42	1.69	0.00	14.78	0.00	0.00	0.00	0.00	0.25	0.92	1.78	0.00	0.00	0.00	0.00	0.00

Energy balance	**2010**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	8720.82	54.37	0.00	0.00	62.84	3744.29	225.85	0.00	0.00	0.00	264.32	3944.24	0.00	424.91	0.00	0.00
1.1.2 Production of natural gas that is flared off	17.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.50	0.00	0.00	0.00	0.00
2. Imports	320.83	19.21	12.37	14.44	6.76	42.22	17.08	17.47	51.21	71.93	15.32	0.00	0.00	0.00	52.82	0.00
3. Exports	7759.76	47.53	0.10	0.69	0.28	3288.84	316.20	7.58	90.06	72.99	244.48	3665.37	0.00	0.00	25.64	0.00
4.1 Bunkering	19.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.75	7.67	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	17.20	0.00	0.00	0.00	0.00	0.00	0.00	17.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	9.43	-6.23	-0.13	0.14	0.00	2.13	8.45	-0.05	7.00	0.79	-2.67	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1272.21	19.83	12.14	13.89	69.33	499.80	-64.83	-7.35	-43.60	-7.94	32.49	296.37	0.00	424.91	27.18	0.00
8. Energy converted	1126.35	0.74	2.63	0.00	15.41	504.53	46.85	3.87	15.38	62.29	12.67	33.05	0.96	424.91	3.04	0.02
8.1. In blast furnaces	2.63	0.00	2.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	631.01	0.00	0.00	0.00	0.00	504.53	46.85	3.87	12.44	62.29	1.04	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	34.25	0.00	0.00	0.00	1.27	0.00	0.00	0.00	0.14	0.00	0.00	32.37	0.46	0.00	0.00	0.00
8.4. In dual purpose pow er plants	7.63	0.74	0.00	0.00	6.33	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.42	0.00	0.05	0.00
8.5. In district heating plants	14.84	0.00	0.00	0.00	7.81	0.00	0.00	0.00	2.72	0.00	0.54	0.68	0.08	0.00	2.99	0.02
8.6. In hydropow er plants	424.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	424.91	0.00	0.00
8.7. Other conversion	11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.09	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1130.86	0.00	0.00	5.69	0.00	0.00	220.46	32.31	264.20	79.46	19.24	0.00	44.38	0.00	445.07	20.05
9. Consumption by energy sector	232.33	0.00	0.00	0.00	0.00	0.00	0.02	0.00	9.19	0.05	0.23	170.80	26.21	0.00	25.55	0.28
9.1.1 Crude petroleum and natural gas production	181.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.76	0.00	0.00	153.09	0.00	0.00	19.46	0.00
9.1.2 Natural gas w hich is flared off on oil fields	17.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.50	0.00	0.00	0.00	0.00
9.2. Coal mines	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.12	0.00
9.3. Petroleum refineries	28.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.23	0.00	26.21	0.00	1.84	0.25
9.4. Pumping storage pow er plants	2.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.07	0.00
9.5. Hydro electric pow er plants	1.96	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.05	0.00	0.00	0.00	0.00	0.00	1.89	0.00
9.6. Thermal pow er plants	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.09	0.00
9.7. Combined heat and pow er plants	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.04	0.00
9.8. District heating plants	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05	0.03
9.9. Gas supply	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	42.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	4.20	0.00	34.16	3.67
11. Statistical differences (7-8+1.2-9-10-13.1)	116.13	0.71	1.05	2.86	0.00	-4.73	56.25	1.36	11.31	-1.27	-10.29	58.88	0.00	0.00	0.00	0.00
	116.13	0.71	1.05	2.86	0.00	-4.73	56.25	1.36	11.31	-1.27	-10.29	58.88	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	885.68	18.39	8.45	16.72	53.92	0.00	52.52	19.73	184.73	10.45	49.12	33.09	13.00	0.00	409.49	16.08
13. Net domestic consumption	808.39	16.19	8.45	0.69	53.92	0.00	52.52	19.73	184.73	10.45	9.50	13.65	13.00	0.00	409.49	16.08
14. Manufacturing, mining and quarrying	249.24	16.18	8.44	0.62	18.02	0.00	0.00	0.03	11.33	7.81	7.37	9.21	12.49	0.00	156.15	1.59
14.1. Mining and quarrying	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.02	2.42	0.03	0.05	0.17	0.04	0.00	2.01	0.01
14.2. Manufacture of paper and paper products	33.88	0.00	0.00	0.00	11.70	0.00	0.00	0.00	0.15	4.21	0.15	0.03	0.09	0.00	17.54	0.00
14.3. Manufacture of industrial chemicals	56.65	5.87	2.30	0.03	1.02	0.00	0.00	0.00	1.46	0.93	2.52	3.64	11.47	0.00	26.86	0.55
14.4. Manufacture of iron, steel and ferro alloys	30.31	7.02	5.70	0.06	0.08	0.00	0.00	0.00	0.30	0.00	0.05	0.05	0.70	0.00	16.35	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	72.09	0.00	0.00	0.10	0.01	0.00	0.00	0.00	0.48	0.00	1.17	3.13	0.00	0.00	67.16	0.04
14.6. Other manufacturing industries	51.56	3.29	0.45	0.43	5.20	0.00	0.00	0.01	6.51	2.63	3.43	2.19	0.19	0.00	26.22	0.99
15. Transport	205.03	0.00	0.00	0.00	4.76	0.00	51.52	15.42	125.96	2.46	0.08	2.36	0.00	0.00	2.47	0.00
15.1. Railw ays and subw ays	3.03	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.00	2.47	0.00
15.2. Air transport	15.50	0.00	0.00	0.00	0.00	0.00	0.08	15.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	150.18	0.00	0.00	0.00	4.18	0.00	49.72	0.00	96.00	0.00	0.08	0.19	0.00	0.00	0.00	0.00
15.4. Coastal shipping	36.33	0.00	0.00	0.00	0.55	0.00	1.72	0.00	29.43	2.46	0.00	2.17	0.00	0.00	0.00	0.00
16. Other sectors	354.12	0.01	0.01	0.07	31.14	0.00	0.99	4.28	47.44	0.19	2.05	2.08	0.51	0.00	250.87	14.49
16.1. Fishing	20.39	0.00	0.00	0.00	0.00	0.00	0.22	0.01	19.35	0.09	0.00	0.00	0.00	0.00	0.72	0.00
16.2. Agriculture	14.32	0.00	0.00	0.00	0.18	0.00	0.01	0.02	5.75	0.00	0.30	0.82	0.00	0.00	7.23	0.01
16.3. Households	185.28	0.01	0.01	0.00	29.80	0.00	0.72	2.66	4.34	0.01	0.57	0.17	0.00	0.00	143.11	3.90
16.4. Other consumers	123.37	0.00	0.00	0.07	0.90	0.00	0.02	1.59	12.54	0.09	0.39	1.08	0.51	0.00	95.59	10.58
16.5 Construction	10.76	0.00	0.00	0.00	0.26	0.00	0.02	0.01	5.45	0.00	0.80	0.02	0.00	0.00	4.21	0.00
12. Consumption for non-energy purposes	77.28	2.19	0.00	16.03	0.00	0.00	0.00	0.00	0.00	0.00	39.62	19.44	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	60.17	0.00	0.00	1.17	0.00	0.00	0.00	0.00	0.00	0.00	39.56	19.44	0.00	0.00	0.00	0.00
12.2 Other manufacturing	17.12	2.19	0.00	14.86	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00

Energy balance	**2011**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	8328.15	38.96	0.00	0.00	66.31	3490.87	212.24	0.00	0.00	0.00	310.35	3767.21	0.00	442.21	0.00	0.00
1.1.2 Production of natural gas that is flared off	17.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.17	0.00	0.00	0.00	0.00
2. Imports	295.96	19.91	13.02	12.92	7.42	48.20	15.78	19.19	52.20	55.71	11.02	0.05	0.00	0.00	40.52	0.00
3. Exports	7429.18	42.26	0.00	1.06	3.78	2907.29	373.90	10.00	129.03	76.10	259.23	3574.94	0.00	0.00	51.58	0.00
4.1 Bunkering	20.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.66	8.52	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	16.04	0.00	0.00	0.00	0.00	0.00	0.00	16.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-20.82	5.24	0.55	-1.80	0.00	-19.03	1.43	-0.09	-10.27	2.50	0.66	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1155.05	21.85	13.57	10.06	69.95	612.75	-144.45	-6.95	-98.76	-26.41	62.81	209.48	0.00	442.21	-11.07	0.00
8. Energy converted	1212.66	1.82	2.71	0.00	17.61	563.27	50.20	8.74	28.61	52.48	12.29	26.56	3.59	442.21	2.53	0.04
8.1. In blast furnaces	3.82	1.11	2.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	702.55	0.00	0.00	0.00	0.00	563.27	50.20	8.74	26.95	52.48	0.90	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	27.92	0.00	0.00	0.00	1.29	0.00	0.00	0.00	0.13	0.00	0.00	25.89	0.61	0.00	0.00	0.00
8.4. In dual purpose pow er plants	12.40	0.71	0.00	0.00	8.63	0.00	0.00	0.00	0.14	0.00	0.00	0.00	2.88	0.00	0.04	0.00
8.5. In district heating plants	12.65	0.00	0.00	0.00	7.70	0.00	0.00	0.00	1.39	0.00	0.28	0.66	0.09	0.00	2.49	0.04
8.6. In hydropow er plants	442.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	442.21	0.00	0.00
8.7. Other conversion	11.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.10	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1215.29	0.00	0.00	7.48	0.00	0.00	239.44	36.52	313.29	74.83	19.85	0.00	44.74	0.00	459.47	19.68
9. Consumption by energy sector	229.56	0.00	0.00	0.00	0.00	0.00	0.02	0.00	9.69	0.00	0.14	165.05	23.69	0.00	30.15	0.82
9.1.1 Crude petroleum and natural gas production	176.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.27	0.00	0.00	147.89	0.00	0.00	19.47	0.00
9.1.2 Natural gas w hich is flared off on oil fields	17.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.17	0.00	0.00	0.00	0.00
9.2. Coal mines	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.13	0.00
9.3. Petroleum refineries	26.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.14	0.00	23.69	0.00	1.98	0.78
9.4. Pumping storage pow er plants	6.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.51	0.00
9.5. Hydro electric pow er plants	1.85	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.07	0.00	0.00	0.00	0.00	0.00	1.77	0.00
9.6. Thermal pow er plants	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
9.7. Combined heat and pow er plants	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.12	0.00
9.8. District heating plants	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.04
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	34.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	3.25	0.00	26.15	4.74
11. Statistical differences (7-8+1.2-9-10-13.1)	34.62	1.81	2.37	0.47	0.00	49.48	-3.21	1.03	-8.69	-13.03	22.16	-17.76	0.00	0.00	0.00	0.00
	34.62	1.81	2.37	0.47	0.00	49.48	-3.21	1.03	-8.69	-13.03	22.16	-17.76	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	858.85	18.23	8.50	17.08	52.34	0.00	47.98	19.79	184.92	8.96	48.07	35.10	14.22	0.00	389.57	14.08
13. Net domestic consumption	780.34	16.04	8.50	0.59	52.34	0.00	47.98	19.79	184.92	8.96	9.30	14.03	14.22	0.00	389.57	14.08
14. Manufacturing, mining and quarrying	249.51	16.03	8.40	0.59	19.94	0.00	0.00	0.03	10.87	6.47	7.23	9.73	13.72	0.00	155.10	1.41
14.1. Mining and quarrying	5.35	0.00	0.00	0.00	0.02	0.00	0.00	0.02	2.82	0.00	0.10	0.18	0.00	0.00	2.19	0.00
14.2. Manufacture of paper and paper products	32.44	0.00	0.00	0.00	13.37	0.00	0.00	0.00	0.13	2.95	0.10	0.09	0.12	0.00	15.67	0.00
14.3. Manufacture of industrial chemicals	56.79	6.29	2.04	0.07	0.89	0.00	0.00	0.00	1.62	0.91	2.66	3.66	11.67	0.00	26.51	0.48
14.4. Manufacture of iron, steel and ferro alloys	32.86	6.53	5.95	0.12	0.11	0.00	0.00	0.00	0.26	0.00	0.07	0.04	1.72	0.00	18.05	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	70.76	0.00	0.00	0.05	0.01	0.00	0.00	0.00	0.33	0.00	0.84	1.92	0.00	0.00	67.57	0.03
14.6. Other manufacturing industries	51.31	3.21	0.42	0.35	5.53	0.00	0.00	0.01	5.71	2.60	3.45	3.83	0.20	0.00	25.10	0.89
15. Transport	205.50	0.00	0.00	0.00	4.72	0.00	46.98	16.34	129.90	2.30	0.08	2.69	0.03	0.00	2.46	0.00
15.1. Railw ays and subw ays	2.98	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	2.46	0.00
15.2. Air transport	16.42	0.00	0.00	0.00	0.00	0.00	0.08	16.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	148.70	0.00	0.00	0.00	4.70	0.00	45.18	0.00	98.50	0.00	0.08	0.21	0.03	0.00	0.00	0.00
15.4. Coastal shipping	37.40	0.00	0.00	0.00	0.00	0.00	1.72	0.00	30.90	2.30	0.00	2.48	0.00	0.00	0.00	0.00
16. Other sectors	325.33	0.01	0.10	0.00	27.67	0.00	1.00	3.42	44.15	0.20	1.99	1.62	0.47	0.00	232.01	12.67
16.1. Fishing	20.86	0.00	0.00	0.00	0.00	0.00	0.23	0.01	19.79	0.11	0.00	0.00	0.00	0.00	0.72	0.00
16.2. Agriculture	13.32	0.00	0.00	0.00	0.18	0.00	0.01	0.01	5.77	0.00	0.24	0.61	0.00	0.00	6.49	0.01
16.3. Households	165.41	0.01	0.01	0.00	26.31	0.00	0.72	1.89	3.14	0.00	0.57	0.14	0.00	0.00	129.78	2.84
16.4. Other consumers	115.19	0.00	0.09	0.00	0.93	0.00	0.03	1.51	10.05	0.09	0.36	0.85	0.47	0.00	90.99	9.82
16.5 Construction	10.54	0.00	0.00	0.00	0.26	0.00	0.02	0.01	5.39	0.00	0.82	0.03	0.00	0.00	4.02	0.00
12. Consumption for non-energy purposes	78.51	2.19	0.00	16.49	0.00	0.00	0.00	0.00	0.00	0.00	38.77	21.07	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	60.85	0.00	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	38.71	21.07	0.00	0.00	0.00	0.00
12.2 Other manufacturing	17.66	2.19	0.00	15.41	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00

Energy balance	**2012**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	8586.94	34.53	0.00	0.00	65.61	3186.16	218.78	0.00	0.00	0.00	335.98	4226.19	0.00	519.69	0.00	0.00
1.1.2 Production of natural gas that is flared off	16.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.41	0.00	0.00	0.00	0.00
2. Imports	282.38	20.32	13.37	13.24	7.08	49.42	19.17	21.68	63.13	48.84	11.02	0.02	0.00	0.00	15.09	0.00
3. Exports	7673.77	35.78	0.05	0.80	3.44	2671.97	371.43	14.99	108.89	67.18	292.03	4027.99	0.00	0.00	79.22	0.00
4.1 Bunkering	19.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.62	6.87	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	18.86	0.00	0.00	0.00	0.00	0.00	0.00	18.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-12.32	2.13	-0.23	0.69	0.00	-3.93	-6.71	0.82	-3.81	0.65	-1.93	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1161.28	21.21	13.09	13.13	69.24	559.68	-140.19	-11.35	-62.19	-24.57	53.04	214.63	0.00	519.69	-64.14	0.00
8. Energy converted	1275.77	1.61	2.62	0.00	20.22	551.62	60.47	9.05	24.16	50.51	10.67	17.21	4.53	519.69	3.37	0.03
8.1. In blast furnaces	3.62	1.00	2.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	695.53	0.00	0.00	0.00	0.00	551.62	60.47	9.05	23.34	50.51	0.55	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	18.47	0.00	0.00	0.00	0.91	0.00	0.00	0.00	0.16	0.00	0.00	16.59	0.81	0.00	0.00	0.00
8.4. In dual purpose pow er plants	14.40	0.61	0.00	0.00	9.98	0.00	0.00	0.00	0.12	0.00	0.00	0.00	3.66	0.00	0.02	0.00
8.5. In district heating plants	14.22	0.00	0.00	0.00	9.33	0.00	0.00	0.00	0.54	0.00	0.28	0.62	0.06	0.00	3.36	0.03
8.6. In hydropow er plants	519.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	519.69	0.00	0.00
8.7. Other conversion	9.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.84	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1274.12	0.00	0.00	5.42	0.00	0.00	250.43	40.48	294.79	67.07	20.48	0.00	43.26	0.00	531.78	20.43
9. Consumption by energy sector	233.67	0.00	0.00	0.00	0.00	0.00	0.01	0.00	9.27	0.00	0.12	167.90	23.04	0.00	33.02	0.31
9.1.1 Crude petroleum and natural gas production	183.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.95	0.00	0.00	151.49	0.00	0.00	23.23	0.00
9.1.2 Natural gas w hich is flared off on oil fields	16.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.41	0.00	0.00	0.00	0.00
9.2. Coal mines	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.14	0.00
9.3. Petroleum refineries	25.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.12	0.00	23.04	0.00	1.93	0.26
9.4. Pumping storage pow er plants	5.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.53	0.00
9.5. Hydro electric pow er plants	1.89	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	1.84	0.00
9.6. Thermal pow er plants	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
9.7. Combined heat and pow er plants	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
9.8. District heating plants	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.05
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	40.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.87	2.55	0.00	32.75	4.27
11. Statistical differences (7-8+1.2-9-10-13.1)	22.16	0.26	2.01	0.70	0.00	8.06	4.98	0.31	10.21	-15.63	17.69	-6.44	0.00	0.00	0.00	0.00
	22.16	0.26	2.01	0.70	0.00	8.06	4.98	0.31	10.21	-15.63	17.69	-6.44	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	863.37	19.34	8.46	17.85	49.02	0.00	44.77	19.77	188.96	7.62	45.04	35.09	13.13	0.00	398.50	15.82
13. Net domestic consumption	789.03	16.94	8.46	0.87	49.02	0.00	44.77	19.77	188.96	7.62	8.30	16.87	13.13	0.00	398.50	15.82
14. Manufacturing, mining and quarrying	238.93	16.93	8.45	0.73	14.73	0.00	0.00	0.03	8.49	5.24	6.37	11.50	12.69	0.00	152.11	1.66
14.1. Mining and quarrying	4.99	0.00	0.00	0.00	0.04	0.00	0.00	0.02	2.60	0.00	0.09	0.17	0.00	0.00	2.07	0.01
14.2. Manufacture of paper and paper products	24.55	0.00	0.00	0.00	7.70	0.00	0.00	0.00	0.08	2.08	0.02	0.23	0.17	0.00	14.27	0.00
14.3. Manufacture of industrial chemicals	54.75	7.33	1.99	0.14	1.49	0.00	0.00	0.00	0.56	0.44	2.71	4.16	10.61	0.00	24.89	0.42
14.4. Manufacture of iron, steel and ferro alloys	32.47	6.39	6.05	0.16	0.11	0.00	0.00	0.00	0.26	0.00	0.04	0.04	1.70	0.00	17.70	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	71.10	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.27	0.00	0.64	1.61	0.00	0.00	68.47	0.06
14.6. Other manufacturing industries	51.07	3.20	0.40	0.39	5.38	0.00	0.00	0.01	4.73	2.72	2.88	5.27	0.21	0.00	24.72	1.16
15. Transport	209.05	0.00	0.00	0.00	5.43	0.00	43.75	16.73	135.17	1.76	0.08	3.66	0.04	0.00	2.44	0.00
15.1. Railw ays and subw ays	3.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.00	2.44	0.00
15.2. Air transport	16.80	0.00	0.00	0.00	0.00	0.00	0.07	16.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	152.17	0.00	0.00	0.00	5.40	0.00	41.96	0.00	104.21	0.00	0.08	0.48	0.04	0.00	0.00	0.00
15.4. Coastal shipping	37.08	0.00	0.00	0.00	0.00	0.00	1.72	0.00	30.42	1.76	0.00	3.17	0.00	0.00	0.00	0.00
16. Other sectors	341.05	0.01	0.01	0.13	28.87	0.00	1.02	3.01	45.30	0.62	1.85	1.72	0.40	0.00	243.95	14.16
16.1. Fishing	22.35	0.00	0.00	0.00	0.00	0.00	0.25	0.01	20.91	0.46	0.00	0.00	0.00	0.00	0.72	0.00
16.2. Agriculture	13.56	0.00	0.00	0.00	0.20	0.00	0.01	0.01	5.67	0.00	0.21	0.65	0.00	0.00	6.80	0.02
16.3. Households	173.91	0.01	0.01	0.00	27.38	0.00	0.72	1.30	2.78	0.00	0.42	0.15	0.00	0.00	137.72	3.42
16.4. Other consumers	119.78	0.00	0.00	0.13	1.01	0.00	0.03	1.67	10.14	0.16	0.36	0.89	0.40	0.00	94.26	10.72
16.5 Construction	11.45	0.00	0.00	0.00	0.28	0.00	0.02	0.01	5.80	0.00	0.86	0.04	0.00	0.00	4.45	0.00
12. Consumption for non-energy purposes	74.34	2.40	0.00	16.98	0.00	0.00	0.00	0.00	0.00	0.00	36.74	18.22	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	55.56	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	36.68	18.22	0.00	0.00	0.00	0.00
12.2 Other manufacturing	18.77	2.40	0.00	16.32	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00

Energy balance	**2013**															
PJ																
	Total	Coal	Coke	Petrol coke	Fuel w ood, black liquor, w aste	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	8150.90	52.13	0.00	0.00	57.93	3031.58	198.81	0.00	0.00	0.00	330.35	4008.81	0.00	471.30	0.00	0.00
1.1.2 Production of natural gas that is flared off	18.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.21	0.00	0.00	0.00	0.00
2. Imports	346.73	17.98	11.90	12.68	7.07	76.81	11.08	25.10	55.75	80.86	11.01	0.00	0.00	0.00	36.49	0.00
3. Exports	7169.54	58.11	0.04	1.55	1.76	2451.89	338.70	15.65	114.66	78.10	290.57	3763.90	0.00	0.00	54.61	0.00
4.1 Bunkering	18.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.47	7.79	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	20.60	0.00	0.00	0.00	0.00	0.00	0.00	20.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-12.97	8.35	0.15	1.06	0.00	-20.62	-0.57	-1.22	-1.09	0.02	0.97	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1294.46	20.35	12.01	12.19	63.24	635.88	-129.39	-12.37	-70.48	-5.02	51.76	263.12	0.00	471.30	-18.12	0.00
8. Energy converted	1256.59	1.75	2.69	0.00	20.69	565.92	53.71	4.60	28.67	71.75	12.03	15.58	4.26	471.30	3.60	0.03
8.1. In blast furnaces	3.73	1.04	2.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	724.93	0.00	0.00	0.00	0.00	565.92	53.71	4.60	27.94	71.75	1.01	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	16.59	0.00	0.00	0.00	0.75	0.00	0.00	0.00	0.14	0.00	0.00	15.05	0.66	0.00	0.00	0.00
8.4. In dual purpose pow er plants	14.84	0.71	0.00	0.00	10.39	0.00	0.00	0.00	0.11	0.00	0.02	0.05	3.52	0.00	0.04	0.00
8.5. In district heating plants	14.45	0.00	0.00	0.00	9.56	0.00	0.00	0.00	0.48	0.00	0.25	0.48	0.09	0.00	3.56	0.03
8.6. In hydropow er plants	471.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	471.30	0.00	0.00
8.7. Other conversion	10.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.75	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1270.35	0.00	0.00	7.42	0.00	0.00	256.01	38.82	318.22	71.88	23.05	0.00	49.32	0.00	483.26	22.37
9. Consumption by energy sector	237.32	0.00	0.00	0.00	0.00	0.00	0.01	0.00	11.94	0.00	0.13	166.93	28.68	0.00	29.58	0.04
9.1.1 Crude petroleum and natural gas production	182.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.60	0.00	0.00	148.71	0.00	0.00	22.39	0.00
9.1.2 Natural gas w hich is flared off on oil fields	18.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.21	0.00	0.00	0.00	0.00
9.2. Coal mines	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.15	0.00
9.3. Petroleum refineries	30.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.13	0.00	28.68	0.00	2.00	0.00
9.4. Pumping storage pow er plants	2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.80	0.00
9.5. Hydro electric pow er plants	2.06	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	2.00	0.00
9.6. Thermal pow er plants	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
9.7. Combined heat and pow er plants	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.14	0.00
9.8. District heating plants	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.04
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	45.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	1.95	0.00	38.60	4.68
11. Statistical differences (7-8+1.2-9-10-13.1)	167.65	-1.79	1.61	1.08	0.00	69.96	31.10	1.66	20.61	-11.85	13.54	41.73	0.00	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	857.45	20.39	7.71	18.52	42.55	0.00	41.80	20.18	186.52	6.95	49.10	38.30	14.43	0.00	393.37	17.62
13. Net domestic consumption	775.65	18.00	7.71	0.78	42.55	0.00	41.80	20.18	186.52	6.95	7.44	18.30	14.43	0.00	393.37	17.62
14. Manufacturing, mining and quarrying	240.20	17.99	7.63	0.78	13.88	0.00	0.00	0.04	9.18	4.78	5.74	12.22	14.06	0.00	151.93	1.97
14.1. Mining and quarrying	5.47	0.00	0.00	0.00	0.04	0.00	0.00	0.01	3.03	0.00	0.07	0.17	0.00	0.00	2.13	0.01
14.2. Manufacture of paper and paper products	21.25	0.00	0.00	0.00	6.67	0.00	0.00	0.00	0.07	1.25	0.04	0.35	0.18	0.00	12.43	0.26
14.3. Manufacture of industrial chemicals	54.99	7.28	1.82	0.00	1.68	0.00	0.00	0.00	0.41	0.72	1.56	4.49	11.80	0.00	24.75	0.47
14.4. Manufacture of iron, steel and ferro alloys	33.23	7.51	5.44	0.30	0.08	0.00	0.00	0.00	0.29	0.00	0.04	0.05	1.89	0.00	17.63	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	71.62	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.22	0.00	0.51	1.53	0.00	0.00	69.23	0.03
14.6. Other manufacturing industries	53.62	3.19	0.37	0.39	5.41	0.00	0.00	0.02	5.15	2.80	3.52	5.64	0.20	0.00	25.75	1.20
15. Transport	207.35	0.00	0.00	0.00	5.24	0.00	40.79	16.82	136.11	1.40	0.08	4.32	0.04	0.00	2.54	0.00
15.1. Railw ays and subw ays	3.18	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00	2.54	0.00
15.2. Air transport	16.87	0.00	0.00	0.00	0.00	0.00	0.05	16.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	153.18	0.00	0.00	0.00	5.22	0.00	39.02	0.00	108.24	0.00	0.08	0.59	0.04	0.00	0.00	0.00
15.4. Coastal shipping	34.12	0.00	0.00	0.00	0.00	0.00	1.72	0.00	27.26	1.40	0.00	3.73	0.00	0.00	0.00	0.00
16. Other sectors	328.10	0.01	0.08	0.00	23.42	0.00	1.01	3.33	41.23	0.77	1.61	1.76	0.33	0.00	238.90	15.65
16.1. Fishing	19.14	0.00	0.00	0.00	0.00	0.00	0.24	0.01	17.54	0.62	0.00	0.00	0.00	0.00	0.72	0.00
16.2. Agriculture	13.85	0.00	0.00	0.00	0.20	0.00	0.01	0.01	5.56	0.00	0.00	0.64	0.00	0.00	7.42	0.02
16.3. Households	164.94	0.01	0.01	0.00	22.02	0.00	0.72	1.67	2.67	0.00	0.36	0.16	0.00	0.00	133.44	3.90
16.4. Other consumers	118.49	0.00	0.07	0.00	0.93	0.00	0.02	1.63	9.57	0.16	0.36	0.94	0.33	0.00	92.75	11.74
16.5 Construction	11.69	0.00	0.00	0.00	0.28	0.00	0.02	0.01	5.89	0.00	0.89	0.03	0.00	0.00	4.58	0.00
12. Consumption for non-energy purposes	81.80	2.39	0.00	17.75	0.00	0.00	0.00	0.00	0.00	0.00	41.66	20.00	0.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	62.31	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	41.60	20.00	0.00	0.00	0.00	0.00
12.2 Other manufacturing	19.49	2.39	0.00	17.04	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00

Part 2: More detailed energy balance sheets for 2008-2013

Footnotes to Part II

Blast furnace gas:
Included in "Other gases" in the regular tables.

Fuel wood:
Included in "Fuel wood, black liquor, waste" in the regular tables.

Other biomass:
Includes wood waste, black liquor, wood pellets and briquettes, landfill gas and other biogases, transport biofuels.
Excludes fuel wood and biomass fractions of municipal waste and hazardous waste.
Included in "Fuel wood, black liquor, waste" in the regular tables.

Waste:
Includes municipal, industrial and hazardous waste. Excludes wood waste and black liquor.
Included in "Fuel wood, black liquor, waste" and "Heavy fuel oil" (for hazardous waste) in the regular tables.

Heavy fuel oil:
Excludes hazardous waste (which is included with heavy fuel oil in the regular tables).

Refinery gas and fuel gas:
Included in "Other gases" in the regular tables.

Refineries: Coke burn-off and calcining:
Included in "Other gases" in the regular tables.

Energy balance	**2008**																			
PJ																				
Footnotes, see page 27 of Annex III							Biogas	Hazardous waste												
	Total	Coal	Coke	Blast furnace gas	Petrol coke	Fuelwood	Other biomass	Waste	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Refinery gas and fuel gas	Refineries: Coke burn-off and calcining	Natural gas	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	9184.29	96.39	0.00	0.00	0.00	21.23	24.58	8.99	4383.35	211.12	0.00	0.00	0.00	279.59	0.00	0.00	3651.82	507.22	0.00	0.00
1.1.2 Production of natural gas that is flared off	33.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.21	0.00	0.00	0.00
2. Imports	240.27	18.10	12.98	0.00	17.47	4.71	0.00	0.00	35.05	19.57	10.89	40.70	60.26	8.24	0.00	0.00	0.00	0.00	12.28	0.00
3. Exports	8162.64	94.10	0.00	0.00	0.25	0.02	0.00	0.00	3770.69	310.50	12.06	105.11	110.87	258.83	0.00	0.00	3438.01	0.00	62.19	0.00
4.1 Bunkering	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.17	11.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	15.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-15.63	2.85	-0.20	0.00	-0.32	0.00	0.00	0.00	-16.58	-0.63	-1.13	0.65	-1.11	0.85	0.00	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1236.27	23.24	12.78	0.00	16.90	25.92	24.58	8.99	631.14	-80.45	-18.04	-79.93	-63.04	29.85	0.00	0.00	247.03	507.22	-49.91	0.00
8. Energy converted	1200.02	0.63	2.02	0.49	0.00	0.00	4.48	7.29	551.10	44.19	0.34	16.50	47.40	12.75	0.00	0.00	3.17	507.22	2.42	0.01
8.1. In blast furnaces	2.02	0.00	2.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	660.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	551.10	44.19	0.34	15.81	47.40	1.30	0.00	0.00	0.00	0.00	0.00	0.00
8.3. In thermal power plants	4.85	0.00	0.00	0.48	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	2.51	0.00	0.00	0.00
8.4. In dual purpose power plants	4.83	0.63	0.00	0.00	0.00	0.00	0.00	4.15	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
8.5. In district heating plants	9.69	0.00	0.00	0.01	0.00	0.00	2.71	3.15	0.00	0.00	0.00	0.54	0.00	0.19	0.00	0.00	0.67	0.00	2.41	0.01
8.6. In hydropower plants	507.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	507.22	0.00	0.00
8.7. Other conversion	11.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.26	0.00	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1218.15	0.00	0.00	1.91	6.29	0.00	1.54	3.74	0.00	207.99	39.85	279.35	95.76	16.31	32.44	7.71	0.00	0.00	511.59	13.68
9. Consumption by energy sector	256.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	7.51	0.00	0.00	19.23	7.71	200.74	0.00	21.15	0.04
9.1.1 Crude petroleum and natural gas production	186.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.87	0.00	0.00	0.00	0.00	167.53	0.00	11.72	0.00
9.1.2 Natural gas which is flared off on oil fields	33.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.21	0.00	0.00	0.00
9.2. Coal mines	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
9.3. Petroleum refineries	28.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	19.23	7.71	0.00	0.00	1.90	0.00
9.4. Pumping storage power plants	4.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.82	0.00
9.5. Hydro electric power plants	2.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	2.19	0.00
9.6. Thermal power plants	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
9.7. Combined heat and power plants	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
9.8. District heating plants	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.04
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	40.88	0.00	0.00	0.25	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.17	0.00	0.45	0.00	34.84	2.62
11. Statistical differences (7-8+1.2-9-10-13.1)	89.25	3.61	0.22	0.00	2.90	0.00	0.00	0.00	80.04	23.91	3.31	10.02	-25.32	-16.42	0.00	0.00	6.98	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	867.86	19.01	10.54	1.17	20.29	25.92	21.09	5.43	0.00	59.40	18.16	165.39	10.64	49.83	11.04	0.00	35.68	0.00	403.28	11.02
13. Net domestic consumption	780.81	16.55	10.54	1.17	0.39	25.92	21.09	5.43	0.00	59.40	18.15	164.90	9.72	9.79	11.04	0.00	12.43	0.00	403.28	11.02
14. Manufacturing, mining and quarrying	272.61	16.54	10.48	1.17	0.39	0.00	16.46	4.88	0.00	0.00	0.07	10.52	4.85	7.67	11.04	0.00	8.77	0.00	178.62	1.14
14.1. Mining and quarrying	4.96	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.03	2.72	0.00	0.04	0.13	0.00	0.19	0.00	1.79	0.01
14.2. Manufacture of paper and paper products	36.93	0.00	0.00	0.00	0.00	0.00	12.91	0.77	0.00	0.00	0.00	0.15	3.27	0.11	0.00	0.00	0.12	0.00	19.61	0.00
14.3. Manufacture of industrial chemicals	55.87	5.80	2.63	0.72	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.38	1.19	2.55	10.91	0.00	3.50	0.00	27.07	0.54
14.4. Manufacture of iron, steel and ferro alloys	33.63	7.39	7.30	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.05	0.00	0.00	0.07	0.00	18.02	0.00
14.5. Manufacture of aluminium and other non-ferrous metals	86.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	1.03	0.00	0.00	2.01	0.00	82.55	0.05
14.6. Other manufacturing industries	55.09	3.35	0.55	0.14	0.39	0.00	3.18	4.06	0.00	0.00	0.05	6.32	0.39	3.89	0.00	0.00	2.87	0.00	29.58	0.54
15. Transport	198.00	0.00	0.00	0.00	0.00	0.00	3.30	0.00	0.00	58.44	14.12	112.91	4.68	0.08	0.00	0.00	2.01	0.00	2.46	0.00
15.1. Railways and subways	3.08	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00	0.00	2.46	0.00
15.2. Air transport	14.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	14.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	146.24	0.00	0.00	0.00	0.00	0.00	3.28	0.00	0.00	56.64	0.00	86.10	0.00	0.08	0.00	0.00	0.14	0.00	0.00	0.00
15.4. Coastal shipping	34.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72	0.00	26.20	4.68	0.00	0.00	0.00	1.87	0.00	0.00	0.00
16. Other sectors	310.21	0.01	0.06	0.00	0.00	25.92	1.33	0.55	0.00	0.96	3.96	41.46	0.19	2.04	0.00	0.00	1.65	0.00	222.20	9.88
16.1. Fishing	17.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	16.16	0.14	0.00	0.00	0.00	0.04	0.00	0.64	0.00
16.2. Agriculture	14.00	0.00	0.00	0.00	0.00	0.00	0.05	0.04	0.00	0.01	0.01	5.92	0.00	0.27	0.00	0.00	0.63	0.00	7.05	0.01
16.3. Households	161.29	0.01	0.01	0.00	0.00	25.92	0.00	0.00	0.00	0.72	2.42	3.29	0.05	0.55	0.00	0.00	0.13	0.00	125.60	2.59
16.4. Other consumers	107.31	0.00	0.05	0.00	0.00	0.00	1.03	0.50	0.00	0.01	1.51	10.53	0.00	0.38	0.00	0.00	0.83	0.00	85.17	7.28
16.5 Construction	10.43	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.02	0.01	5.56	0.00	0.83	0.00	0.00	0.02	0.00	3.74	0.00
12. Consumption for non-energy purposes	87.04	2.45	0.00	0.00	19.89	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.92	40.04	0.00	0.00	23.25	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	62.98	0.00	0.00	0.00	1.23	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	38.26	0.00	0.00	23.25	0.00	0.00	0.00
12.2 Other manufacturing	24.06	2.45	0.00	0.00	18.66	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.92	1.78	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2009**																			
PJ																				
Footnotes, see page 27 of Annex III																				
	Total	Coal	Coke	Blast furnace gas	Petrol coke	Fuelw ood	Other biomass	Waste	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Refinery gas and fuel gas	Refineries: Coke burn-off and calcining	Natural gas	Waterfall energy and w ind pow er	Electricity	District heating
1.1.1 Production of primary energy bearers	9047.59	74.20	0.00	0.00	0.00	21.75	22.29	9.67	4146.54	237.54	0.00	0.00	0.00	274.08	0.00	0.00	3804.12	457.39	0.00	0.00
1.1.2 Production of natural gas that is flared off	17.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.98	0.00	0.00	0.00
2. Imports	280.26	11.83	7.94	0.00	13.30	4.96	0.00	0.00	51.84	16.55	8.65	73.58	59.29	12.00	0.00	0.00	0.00	0.00	20.34	0.00
3. Exports	8187.11	67.35	0.00	0.00	0.05	0.07	0.00	0.00	3645.00	366.74	6.00	97.92	84.55	269.18	0.00	0.00	3597.57	0.00	52.68	0.00
4.1 Bunkering	23.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.35	8.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	14.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	23.95	-3.64	0.43	0.00	0.34	0.00	0.00	0.00	22.80	-0.32	0.38	2.17	-1.30	3.09	0.00	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1144.40	15.04	8.37	0.00	13.58	26.64	22.29	9.67	576.17	-112.97	-11.93	-36.52	-35.51	19.99	0.00	0.00	224.53	457.39	-32.34	0.00
8. Energy converted	1175.65	0.74	1.50	0.31	0.00	0.00	4.33	7.89	547.70	46.48	1.08	14.97	54.82	11.57	0.00	0.00	23.72	457.39	3.12	0.02
8.1. In blast furnaces	1.50	0.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	665.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	547.70	46.48	1.08	13.73	54.82	1.19	0.00	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	24.66	0.00	0.00	0.29	0.00	0.00	1.09	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	23.15	0.00	0.00	0.00
8.4. In dual purpose pow er plants	5.66	0.74	0.00	0.00	0.00	0.00	0.00	4.76	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
8.5. In district heating plants	11.38	0.00	0.00	0.02	0.00	0.00	3.24	3.14	0.00	0.00	0.00	1.00	0.00	0.34	0.00	0.00	0.57	0.00	3.06	0.02
8.6. In hydropow er plants	457.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	457.39	0.00	0.00
8.7. Other conversion	10.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.04	0.00	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1188.68	0.00	0.00	1.42	5.30	0.00	1.42	3.53	0.00	232.31	34.52	278.90	81.69	19.83	29.73	9.96	0.00	0.00	474.38	15.70
9. Consumption by energy sector	240.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	8.75	0.00	0.14	17.99	9.96	177.71	0.00	25.49	0.03
9.1.1 Crude petroleum and natural gas production	184.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.31	0.00	0.00	0.00	0.00	159.73	0.00	16.78	0.00
9.1.2 Natural gas w hich is flared off on oil fields	17.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.98	0.00	0.00	0.00
9.2. Coal mines	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
9.3. Petroleum refineries	30.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.14	17.99	9.96	0.00	0.00	2.06	0.00
9.4. Pumping storage pow er plants	4.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.09	0.00
9.5. Hydro electric pow er plants	2.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.00	2.24	0.00
9.6. Thermal pow er plants	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
9.7. Combined heat and pow er plants	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
9.8. District heating plants	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.03
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	37.70	0.00	0.00	0.20	0.00	0.00	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.88	0.00	0.70	0.00	31.06	3.22
11. Statistical differences (7-8+1.2-9-10-13.1)	54.40	0.31	-0.01	0.00	2.98	0.00	0.00	0.00	28.47	17.07	3.17	49.22	-17.81	-19.63	0.00	0.00	-9.39	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	825.23	14.00	6.88	0.91	15.89	26.64	18.74	5.31	0.00	55.76	18.32	169.43	9.18	47.73	9.86	0.00	31.80	0.00	382.36	12.43
13. Net domestic consumption	749.25	12.31	6.88	0.91	0.34	26.64	18.74	5.31	0.00	55.76	18.32	168.94	8.26	9.00	9.86	0.00	13.21	0.00	382.36	12.43
14. Manufacturing, mining and quarrying	223.91	12.30	6.87	0.91	0.29	0.00	13.48	4.81	0.00	0.00	0.05	8.84	4.28	6.94	9.86	0.00	9.24	0.00	144.77	1.28
14.1. Mining and quarrying	3.72	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02	1.86	0.02	0.04	0.03	0.00	0.15	0.00	1.57	0.01
14.2. Manufacture of paper and paper products	30.62	0.00	0.00	0.00	0.00	0.00	9.80	0.76	0.00	0.00	0.00	0.39	2.89	0.13	0.00	0.00	0.03	0.00	16.62	0.00
14.3. Manufacture of industrial chemicals	48.25	3.80	1.45	0.51	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.63	1.23	3.00	9.82	0.00	4.50	0.00	22.32	0.47
14.4. Manufacture of iron, steel and ferro alloys	23.49	5.06	4.95	0.24	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.47	0.00	0.04	0.00	0.00	0.05	0.00	12.64	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	71.88	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.88	0.00	0.00	1.87	0.00	68.71	0.03
14.6. Other manufacturing industries	45.95	3.44	0.46	0.17	0.20	0.00	3.27	4.04	0.00	0.00	0.03	5.18	0.14	2.85	0.00	0.00	2.64	0.00	22.91	0.77
15. Transport	197.20	0.00	0.00	0.00	0.00	0.00	3.90	0.00	0.00	54.77	14.57	115.51	3.87	0.08	0.00	0.00	2.14	0.00	2.37	0.00
15.1. Railw ays and subw ays	2.99	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	2.37	0.00
15.2. Air transport	14.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	14.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	144.38	0.00	0.00	0.00	0.00	0.00	3.87	0.00	0.00	52.97	0.00	87.31	0.00	0.08	0.00	0.00	0.14	0.00	0.00	0.00
15.4. Coastal shipping	35.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72	0.00	27.60	3.87	0.00	0.00	0.00	1.99	0.00	0.00	0.00
16. Other sectors	328.14	0.01	0.01	0.00	0.04	26.64	1.35	0.50	0.00	0.99	3.70	44.60	0.11	1.98	0.00	0.00	1.83	0.00	235.23	11.16
16.1. Fishing	19.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.01	18.57	0.11	0.00	0.00	0.00	0.00	0.00	0.72	0.00
16.2. Agriculture	13.85	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.01	0.01	5.75	0.00	0.28	0.00	0.00	0.69	0.00	6.96	0.02
16.3. Households	167.24	0.01	0.01	0.00	0.00	26.64	0.00	0.00	0.00	0.72	2.16	3.58	0.01	0.54	0.00	0.00	0.15	0.00	130.73	2.70
16.4. Other consumers	116.99	0.00	0.00	0.00	0.04	0.00	0.95	0.50	0.00	0.03	1.51	11.23	0.00	0.37	0.00	0.00	0.96	0.00	92.96	8.44
16.5 Construction	10.43	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.02	0.01	5.47	0.00	0.79	0.00	0.00	0.04	0.00	3.86	0.00
12. Consumption for non-energy purposes	75.98	1.69	0.00	0.00	15.55	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.92	38.73	0.00	0.00	18.59	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	56.56	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	36.95	0.00	0.00	18.59	0.00	0.00	0.00
12.2 Other manufacturing	19.42	1.69	0.00	0.00	14.78	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.92	1.78	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2010**																			
PJ																				
Footnotes, see page 27 of Annex III																				
	Total	Coal	Coke	Blast furnace gas	Petrol coke	Fuelw ood	Other biomass	Waste	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Refinery gas and fuel gas	Refineries: Coke burn-off and calcining	Natural gas	Waterfall energy and w ind pow er	Electricity	District heating
1.1.1 Production of primary energy bearers	8720.82	54.37	0.00	0.00	0.00	23.32	28.33	11.20	3744.29	225.85	0.00	0.00	0.00	264.32	0.00	0.00	3944.24	424.91	0.00	0.00
1.1.2 Production of natural gas that is flared off	17.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.50	0.00	0.00	0.00
2. Imports	320.83	19.21	12.37	0.00	14.44	6.76	0.00	0.00	42.22	17.08	17.47	51.21	71.93	15.32	0.00	0.00	0.00	0.00	52.82	0.00
3. Exports	7759.76	47.53	0.10	0.00	0.69	0.28	0.00	0.00	3288.84	316.20	7.58	90.06	72.99	244.48	0.00	0.00	3665.37	0.00	25.64	0.00
4.1 Bunkering	19.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.75	7.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	17.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	9.43	-6.23	-0.13	0.00	0.14	0.00	0.00	0.00	2.13	8.45	-0.05	7.00	0.79	-2.67	0.00	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1272.21	19.83	12.14	0.00	13.89	29.80	28.33	11.20	499.80	-64.83	-7.35	-43.60	-7.94	32.49	0.00	0.00	296.37	424.91	27.18	0.00
8. Energy converted	1126.35	0.74	2.63	0.35	0.00	0.00	6.23	9.38	504.53	46.85	3.87	15.38	62.29	12.67	0.41	0.00	33.05	424.91	3.04	0.02
8.1. In blast furnaces	2.63	0.00	2.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	631.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	504.53	46.85	3.87	12.44	62.29	1.04	0.00	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	34.25	0.00	0.00	0.33	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	32.37	0.00	0.00	0.00
8.4. In dual purpose pow er plants	7.63	0.74	0.00	0.00	0.00	0.00	0.07	6.27	0.00	0.00	0.00	0.09	0.00	0.00	0.41	0.00	0.00	0.00	0.05	0.00
8.5. In district heating plants	14.84	0.00	0.00	0.02	0.00	0.00	4.75	3.12	0.00	0.00	0.00	2.72	0.00	0.54	0.00	0.00	0.68	0.00	2.99	0.02
8.6. In hydropow er plants	424.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	424.91	0.00	0.00
8.7. Other conversion	11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.09	0.00	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1130.86	0.00	0.00	2.49	5.69	0.00	1.34	3.49	0.00	220.46	32.31	264.20	75.98	19.24	30.42	10.13	0.00	0.00	445.07	20.05
9. Consumption by energy sector	232.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	9.19	0.05	0.23	16.08	10.13	170.80	0.00	25.55	0.28
9.1.1 Crude petroleum and natural gas production	181.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.76	0.00	0.00	0.00	0.00	153.09	0.00	19.46	0.00
9.1.2 Natural gas w hich is flared off on oil fields	17.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.50	0.00	0.00	0.00
9.2. Coal mines	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
9.3. Petroleum refineries	28.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.23	16.08	10.13	0.00	0.00	1.84	0.25
9.4. Pumping storage pow er plants	2.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.07	0.00
9.5. Hydro electric pow er plants	1.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	1.89	0.00
9.6. Thermal pow er plants	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
9.7. Combined heat and pow er plants	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
9.8. District heating plants	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.03
9.9. Gas supply	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00
10. Losses in transport and distribution	42.58	0.00	0.00	0.58	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.09	0.00	0.55	0.00	34.16	3.67
11. Statistical differences (7-8+1.2-9-10-13.1)	116.13	0.71	1.05	0.00	2.86	0.00	0.00	0.00	-4.73	56.25	1.36	11.31	-1.27	-10.29	0.00	0.00	58.88	0.00	0.00	0.00
13.1 Net domestic consumption including non-energy use	885.68	18.39	8.45	1.55	16.72	29.80	22.91	5.30	0.00	52.52	19.73	184.73	6.96	49.12	10.85	0.00	33.09	0.00	409.49	16.08
13. Net domestic consumption	808.39	16.19	8.45	1.55	0.69	29.80	22.91	5.30	0.00	52.52	19.73	184.73	6.96	9.50	10.85	0.00	13.65	0.00	409.49	16.08
14. Manufacturing, mining and quarrying	249.24	16.18	8.44	1.55	0.62	0.00	16.29	5.22	0.00	0.00	0.03	11.33	4.41	7.37	10.85	0.00	9.21	0.00	156.15	1.59
14.1. Mining and quarrying	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02	2.42	0.02	0.05	0.04	0.00	0.17	0.00	2.01	0.01
14.2. Manufacture of paper and paper products	33.88	0.00	0.00	0.00	0.00	0.00	11.80	0.84	0.00	0.00	0.00	0.15	3.37	0.15	0.00	0.00	0.03	0.00	17.54	0.00
14.3. Manufacture of industrial chemicals	56.65	5.87	2.30	0.67	0.03	0.00	0.88	0.00	0.00	0.00	0.00	1.46	0.93	2.52	10.80	0.00	3.64	0.00	26.86	0.55
14.4. Manufacture of iron, steel and ferro alloys	30.31	7.02	5.70	0.70	0.06	0.00	0.08	0.00	0.00	0.00	0.00	0.30	0.00	0.05	0.00	0.00	0.05	0.00	16.35	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	72.09	0.00	0.00	0.00	0.10	0.00	0.01	0.00	0.00	0.00	0.00	0.48	0.00	1.17	0.00	0.00	3.13	0.00	67.16	0.04
14.6. Other manufacturing industries	51.56	3.29	0.45	0.19	0.43	0.00	3.53	4.37	0.00	0.00	0.01	6.51	0.08	3.43	0.00	0.00	2.19	0.00	26.22	0.99
15. Transport	205.03	0.00	0.00	0.00	0.00	0.00	4.76	0.00	0.00	51.52	15.42	125.96	2.46	0.08	0.00	0.00	2.36	0.00	2.47	0.00
15.1. Railw ays and subw ays	3.03	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	2.47	0.00
15.2. Air transport	15.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	15.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	150.18	0.00	0.00	0.00	0.00	0.00	4.19	0.00	0.00	49.72	0.00	96.00	0.00	0.08	0.00	0.00	0.19	0.00	0.00	0.00
15.4. Coastal shipping	36.33	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00	1.72	0.00	29.43	2.46	0.00	0.00	0.00	2.17	0.00	0.00	0.00
16. Other sectors	354.12	0.01	0.01	0.00	0.07	29.80	1.85	0.09	0.00	0.99	4.28	47.44	0.10	2.05	0.00	0.00	2.08	0.00	250.87	14.49
16.1. Fishing	20.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.01	19.35	0.09	0.00	0.00	0.00	0.00	0.00	0.72	0.00
16.2. Agriculture	14.32	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.01	0.02	5.75	0.00	0.30	0.00	0.00	0.82	0.00	7.23	0.01
16.3. Households	185.28	0.01	0.01	0.00	0.00	29.80	0.00	0.00	0.00	0.72	2.66	4.34	0.01	0.57	0.00	0.00	0.17	0.00	143.11	3.90
16.4. Other consumers	123.37	0.00	0.00	0.00	0.07	0.00	1.41	0.09	0.00	0.02	1.59	12.54	0.00	0.39	0.00	0.00	1.08	0.00	95.59	10.58
16.5 Construction	10.76	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.02	0.01	5.45	0.00	0.80	0.00	0.00	0.02	0.00	4.21	0.00
12. Consumption for non-energy purposes	77.28	2.19	0.00	0.00	16.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.62	0.00	0.00	19.44	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	60.17	0.00	0.00	0.00	1.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.56	0.00	0.00	19.44	0.00	0.00	0.00
12.2 Other manufacturing	17.12	2.19	0.00	0.00	14.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2011**																			
PJ																				
Footnotes, see page 27 of Annex III																				
	Total	Coal	Coke	Blast furnace gas	Petrol coke	Fuelw ood	Other biomass	Waste	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Refinery gas and fuel gas	Refineries: Coke burn-off and calcining	Natural gas	Waterfall energy and w ind pow er	Electricity	District heating
1.1.1 Production of primary energy bearers	8328.15	38.96	0.00	0.00	0.00	22.67	29.95	13.68	3490.87	212.24	0.00	0.00	0.00	310.35	0.00	0.00	3767.21	442.21	0.00	0.00
1.1.2 Production of natural gas that is flared off	17.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.17	0.00	0.00	0.00
2. Imports	295.96	19.91	13.02	0.00	12.92	7.42	0.00	0.00	48.20	15.78	19.19	52.20	55.71	11.02	0.00	0.00	0.05	0.00	40.52	0.00
3. Exports	7429.18	42.26	0.00	0.00	1.06	3.78	0.00	0.00	2907.29	373.90	10.00	129.03	76.10	259.23	0.00	0.00	3574.94	0.00	51.58	0.00
4.1 Bunkering	20.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.66	8.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	16.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-20.82	5.24	0.55	0.00	-1.80	0.00	0.00	0.00	-19.03	1.43	-0.09	-10.27	2.50	0.66	0.00	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1155.05	21.85	13.57	0.00	10.06	26.31	29.95	13.68	612.75	-144.45	-6.95	-98.76	-26.41	62.81	0.00	0.00	209.48	442.21	-11.07	0.00
8. Energy converted	1212.66	1.82	2.71	0.55	0.00	0.00	5.92	11.87	563.27	50.20	8.74	28.61	52.48	12.29	2.87	0.00	26.56	442.21	2.53	0.04
8.1. In blast furnaces	3.82	1.11	2.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	702.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	563.27	50.20	8.74	26.95	52.48	0.90	0.00	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	27.92	0.00	0.00	0.52	0.00	0.00	1.38	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	25.89	0.00	0.00	0.00
8.4. In dual purpose pow er plants	12.40	0.71	0.00	0.00	0.00	0.00	0.20	8.45	0.00	0.00	0.00	0.14	0.00	0.00	2.87	0.00	0.00	0.00	0.04	0.00
8.5. In district heating plants	12.65	0.00	0.00	0.03	0.00	0.00	4.34	3.42	0.00	0.00	0.00	1.39	0.00	0.28	0.00	0.00	0.66	0.00	2.49	0.04
8.6. In hydropow er plants	442.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	442.21	0.00	0.00
8.7. Other conversion	11.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.10	0.00	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1215.29	0.00	0.00	3.74	7.48	0.00	1.24	3.36	0.00	239.44	36.52	313.29	71.47	19.85	29.77	10.00	0.00	0.00	459.47	19.68
9. Consumption by energy sector	229.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	9.69	0.00	0.14	13.70	10.00	165.05	0.00	30.15	0.82
9.1.1 Crude petroleum and natural gas production	176.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.27	0.00	0.00	0.00	0.00	147.89	0.00	19.47	0.00
9.1.2 Natural gas w hich is flared off on oil fields	17.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.17	0.00	0.00	0.00
9.2. Coal mines	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
9.3. Petroleum refineries	26.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.14	13.70	10.00	0.00	0.00	1.98	0.78
9.4. Pumping storage pow er plants	6.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.51	0.00
9.5. Hydro electric pow er plants	1.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	1.77	0.00
9.6. Thermal pow er plants	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
9.7. Combined heat and pow er plants	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
9.8. District heating plants	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.04
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	34.66	0.00	0.00	0.56	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.24	0.00	0.53	0.00	26.15	4.74
11. Statistical differences (7-8+1.2-9-10-13.1)	34.62	1.81	2.37	-0.17	0.47	0.00	0.00	0.00	49.48	-3.21	1.03	-8.69	-13.03	22.16	0.00	0.00	-17.76	0.00	0.00	0.00
				0.00		0.00	0.00	0.00					0.00		0.00	0.00				
13.1 Net domestic consumption including non-energy use	858.85	18.23	8.50	2.80	17.08	26.31	24.83	5.17	0.00	47.98	19.79	184.92	5.61	48.07	10.97	0.00	35.10	0.00	389.57	14.08
13. Net domestic consumption	780.34	16.04	8.50	2.80	0.59	26.31	24.83	5.17	0.00	47.98	19.79	184.92	5.61	9.30	10.97	0.00	14.03	0.00	389.57	14.08
14. Manufacturing, mining and quarrying	249.51	16.03	8.40	2.80	0.59	0.00	18.25	5.08	0.00	0.00	0.03	10.87	3.20	7.23	10.97	0.00	9.73	0.00	155.10	1.41
14.1. Mining and quarrying	5.35	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	2.82	0.00	0.10	0.00	0.00	0.18	0.00	2.19	0.00
14.2. Manufacture of paper and paper products	32.44	0.00	0.00	0.00	0.00	0.00	13.50	0.62	0.00	0.00	0.00	0.13	2.33	0.10	0.00	0.00	0.09	0.00	15.67	0.00
14.3. Manufacture of industrial chemicals	56.79	6.29	2.04	0.71	0.07	0.00	0.77	0.08	0.00	0.00	0.00	1.62	0.83	2.66	10.96	0.00	3.66	0.00	26.51	0.48
14.4. Manufacture of iron, steel and ferro alloys	32.86	6.53	5.95	1.89	0.12	0.00	0.11	0.00	0.00	0.00	0.00	0.26	0.00	0.07	0.00	0.00	0.04	0.00	18.05	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	70.76	0.00	0.00	0.00	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.33	0.00	0.84	0.00	0.00	1.92	0.00	67.57	0.03
14.6. Other manufacturing industries	51.31	3.21	0.42	0.20	0.35	0.00	3.82	4.38	0.00	0.00	0.01	5.71	0.04	3.45	0.00	0.00	3.83	0.00	25.10	0.89
15. Transport	205.50	0.00	0.00	0.00	0.00	0.00	4.75	0.00	0.00	46.98	16.34	129.90	2.30	0.08	0.00	0.00	2.69	0.00	2.46	0.00
15.1. Railw ays and subw ays	2.98	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	2.46	0.00
15.2. Air transport	16.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	16.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	148.70	0.00	0.00	0.00	0.00	0.00	4.72	0.00	0.00	45.18	0.00	98.50	0.00	0.08	0.00	0.00	0.21	0.00	0.00	0.00
15.4. Coastal shipping	37.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72	0.00	30.90	2.30	0.00	0.00	0.00	2.48	0.00	0.00	0.00
16. Other sectors	325.33	0.01	0.10	0.00	0.00	26.31	1.84	0.09	0.00	1.00	3.42	44.15	0.11	1.99	0.00	0.00	1.62	0.00	232.01	12.67
16.1. Fishing	20.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.01	19.79	0.11	0.00	0.00	0.00	0.00	0.00	0.72	0.00
16.2. Agriculture	13.32	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.01	0.01	5.77	0.00	0.24	0.00	0.00	0.61	0.00	6.49	0.01
16.3. Households	165.41	0.01	0.01	0.00	0.00	26.31	0.00	0.00	0.00	0.72	1.89	3.14	0.00	0.57	0.00	0.00	0.14	0.00	129.78	2.84
16.4. Other consumers	115.19	0.00	0.09	0.00	0.00	0.00	1.40	0.09	0.00	0.03	1.51	10.05	0.00	0.36	0.00	0.00	0.85	0.00	90.99	9.82
16.5 Construction	10.54	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.02	0.01	5.39	0.00	0.82	0.00	0.00	0.03	0.00	4.02	0.00
12. Consumption for non-energy purposes	78.51	2.19	0.00	0.00	16.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.77	0.00	0.00	21.07	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	60.85	0.00	0.00	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.71	0.00	0.00	21.07	0.00	0.00	0.00
12.2 Other manufacturing	17.66	2.19	0.00	0.00	15.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2012**																			
PJ																				
Footnotes, see page 27 of Annex III																				
	Total	Coal	Coke	Blast furnace gas	Petrol coke	Fuelwood	Other biomass	Waste	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Refinery gas and fuel gas	Refineries: Coke burn-off and calcining	Natural gas	Waterfall energy and wind power	Electricity	District heating
1.1.1 Production of primary energy bearers	8586.94	34.53	0.00	0.00	0.00	23.75	26.74	15.13	3186.16	218.78	0.00	0.00	0.00	335.98	0.00	0.00	4226.19	519.69	0.00	0.00
1.1.2 Production of natural gas that is flared off	16.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.41	0.00	0.00	0.00
2. Imports	282.38	20.32	13.37	0.00	13.24	7.08	0.00	0.00	49.42	19.17	21.68	63.13	48.84	11.02	0.00	0.00	0.02	0.00	15.09	0.00
3. Exports	7673.77	35.78	0.05	0.00	0.80	3.44	0.00	0.00	2671.97	371.43	14.99	108.89	67.18	292.03	0.00	0.00	4027.99	0.00	79.22	0.00
4.1 Bunkering	19.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.62	6.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	18.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-12.32	2.13	-0.23	0.00	0.69	0.00	0.00	0.00	-3.93	-6.71	0.82	-3.81	0.65	-1.93	0.00	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1161.28	21.21	13.09	0.00	13.13	27.38	26.74	15.13	559.68	-140.19	-11.35	-62.19	-24.57	53.04	0.00	0.00	214.63	519.69	-64.14	0.00
8. Energy converted	1275.77	1.61	2.62	0.67	0.00	0.00	6.98	13.46	551.62	60.47	9.05	24.16	50.51	10.67	3.64	0.00	17.21	519.69	3.37	0.03
8.1. In blast furnaces	3.62	1.00	2.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	695.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	551.62	60.47	9.05	23.34	50.51	0.55	0.00	0.00	0.00	0.00	0.00	0.00
8.3. In thermal power plants	18.47	0.00	0.00	0.66	0.00	0.00	1.06	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	16.59	0.00	0.00	0.00
8.4. In dual purpose power plants	14.40	0.61	0.00	0.00	0.00	0.00	0.52	9.48	0.00	0.00	0.00	0.12	0.00	0.00	3.64	0.00	0.00	0.00	0.02	0.00
8.5. In district heating plants	14.22	0.00	0.00	0.01	0.00	0.00	5.40	3.98	0.00	0.00	0.00	0.54	0.00	0.28	0.00	0.00	0.62	0.00	3.36	0.03
8.6. In hydropower plants	519.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	519.69	0.00	0.00
8.7. Other conversion	9.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.84	0.00	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1274.12	0.00	0.00	3.65	5.42	0.00	1.21	3.58	0.00	250.43	40.48	294.79	63.49	20.48	28.21	10.40	0.00	0.00	531.78	20.43
9. Consumption by energy sector	233.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	9.27	0.00	0.12	12.64	10.40	167.90	0.00	33.02	0.31
9.1.1 Crude petroleum and natural gas production	183.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.95	0.00	0.00	0.00	0.00	151.49	0.00	23.23	0.00
9.1.2 Natural gas which is flared off on oil fields	16.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.41	0.00	0.00	0.00
9.2. Coal mines	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
9.3. Petroleum refineries	25.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.12	12.64	10.40	0.00	0.00	1.93	0.26
9.4. Pumping storage power plants	5.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.53	0.00
9.5. Hydro electric power plants	1.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	1.84	0.00
9.6. Thermal power plants	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
9.7. Combined heat and power plants	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
9.8. District heating plants	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.05
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	40.44	0.00	0.00	0.21	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.98	0.00	0.87	0.00	32.75	4.27
11. Statistical differences (7-8+1.2-9-10-13.1)	22.16	0.26	2.01	-0.09	0.70	0.00	0.01	0.00	8.06	4.98	0.31	10.21	-15.63	17.69	0.00	0.00	-6.44	0.00	0.00	0.00
				0.00		0.00	0.00	0.00					0.00		0.00	0.00				
13.1 Net domestic consumption including non-energy use	863.37	19.34	8.46	2.86	17.85	27.38	20.60	5.24	0.00	44.77	19.77	188.96	4.04	45.04	9.95	0.00	35.09	0.00	398.50	15.82
13. Net domestic consumption	789.03	16.94	8.46	2.86	0.87	27.38	20.60	5.24	0.00	44.77	19.77	188.96	4.04	8.30	9.95	0.00	16.87	0.00	398.50	15.82
14. Manufacturing, mining and quarrying	238.93	16.93	8.45	2.86	0.73	0.00	13.24	5.08	0.00	0.00	0.03	8.49	1.82	6.37	9.95	0.00	11.50	0.00	152.11	1.66
14.1. Mining and quarrying	4.99	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.02	2.60	0.00	0.09	0.00	0.00	0.17	0.00	2.07	0.01
14.2. Manufacture of paper and paper products	24.55	0.00	0.00	0.00	0.00	0.00	7.87	0.62	0.00	0.00	0.00	0.08	1.46	0.02	0.00	0.00	0.23	0.00	14.27	0.00
14.3. Manufacture of industrial chemicals	54.75	7.33	1.99	0.65	0.14	0.00	1.35	0.08	0.00	0.00	0.00	0.56	0.36	2.71	9.95	0.00	4.16	0.00	24.89	0.42
14.4. Manufacture of iron, steel and ferro alloys	32.47	6.39	6.05	2.01	0.16	0.00	0.11	0.00	0.00	0.00	0.00	0.26	0.00	0.04	0.00	0.00	0.04	0.00	17.70	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	71.10	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.64	0.00	0.00	1.61	0.00	68.47	0.06
14.6. Other manufacturing industries	51.07	3.20	0.40	0.21	0.39	0.00	3.86	4.38	0.00	0.00	0.01	4.73	0.00	2.88	0.00	0.00	5.27	0.00	24.72	1.16
15. Transport	209.05	0.00	0.00	0.00	0.00	0.00	5.47	0.00	0.00	43.75	16.73	135.17	1.76	0.08	0.00	0.00	3.66	0.00	2.44	0.00
15.1. Railways and subways	3.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00	2.44	0.00
15.2. Air transport	16.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	16.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	152.17	0.00	0.00	0.00	0.00	0.00	5.44	0.00	0.00	41.96	0.00	104.21	0.00	0.08	0.00	0.00	0.48	0.00	0.00	0.00
15.4. Coastal shipping	37.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72	0.00	30.42	1.76	0.00	0.00	0.00	3.17	0.00	0.00	0.00
16. Other sectors	341.05	0.01	0.01	0.00	0.13	27.38	1.89	0.16	0.00	1.02	3.01	45.30	0.46	1.85	0.00	0.00	1.72	0.00	243.95	14.16
16.1. Fishing	22.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.01	20.91	0.46	0.00	0.00	0.00	0.00	0.00	0.72	0.00
16.2. Agriculture	13.56	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.01	0.01	5.67	0.00	0.21	0.00	0.00	0.65	0.00	6.80	0.02
16.3. Households	173.91	0.01	0.01	0.00	0.00	27.38	0.00	0.00	0.00	0.72	1.30	2.78	0.00	0.42	0.00	0.00	0.15	0.00	137.72	3.42
16.4. Other consumers	119.78	0.00	0.00	0.00	0.13	0.00	1.41	0.16	0.00	0.03	1.67	10.14	0.00	0.36	0.00	0.00	0.89	0.00	94.26	10.72
16.5 Construction	11.45	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.02	0.01	5.80	0.00	0.86	0.00	0.00	0.04	0.00	4.45	0.00
12. Consumption for non-energy purposes	74.34	2.40	0.00	0.00	16.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.74	0.00	0.00	18.22	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	55.56	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.68	0.00	0.00	18.22	0.00	0.00	0.00
12.2 Other manufacturing	18.77	2.40	0.00	0.00	16.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00

Energy balance	**2013**																			
PJ																				
Footnotes, see page 27 of Annex III																				
	Total	Coal	Coke	Blast furnace gas	Petrol coke	Fuelw ood	Other biomass	Waste	Crude oil	Petrol	Kerosene	Middle distillates	Heavy fuel oil	LPG	Refinery gas and fuel gas	Refineries: Coke burn-off and calcining	Natural gas	Waterfall energy and w ind pow er	Electricity	District heating
1.1.1 Production of primary energy bearers	8150.90	52.13	0.00	0.00	0.00	16.71	25.69	15.53	3031.58	198.81	0.00	0.00	0.00	330.35	0.00	0.00	4008.81	471.30	0.00	0.00
1.1.2 Production of natural gas that is flared off	18.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.21	0.00	0.00	0.00
2. Imports	346.73	17.98	11.90	0.00	12.68	7.07	0.00	0.00	76.81	11.08	25.10	55.75	80.86	11.01	0.00	0.00	0.00	0.00	36.49	0.00
3. Exports	7169.54	58.11	0.04	0.00	1.55	1.76	0.00	0.00	2451.89	338.70	15.65	114.66	78.10	290.57	0.00	0.00	3763.90	0.00	54.61	0.00
4.1 Bunkering	18.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.47	7.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Foreign aviation	20.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Changes in stocks (+ net decrease, - net increase)	-12.97	8.35	0.15	0.00	1.06	0.00	0.00	0.00	-20.62	-0.57	-1.22	-1.09	0.02	0.97	0.00	0.00	0.00	0.00	0.00	0.00
7. Net domestic supply (1.1.1+1.1.2+2-3-4.1-4.2+5)	1294.46	20.35	12.01	0.00	12.19	22.02	25.69	15.53	635.88	-129.39	-12.37	-70.48	-5.02	51.76	0.00	0.00	263.12	471.30	-18.12	0.00
8. Energy converted	1256.59	1.75	2.69	0.52	0.00	0.00	6.97	13.97	565.92	53.71	4.60	28.67	71.75	12.03	3.50	0.00	15.58	471.30	3.60	0.03
8.1. In blast furnaces	3.73	1.04	2.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.2. In crude petroleum refineries	724.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	565.92	53.71	4.60	27.94	71.75	1.01	0.00	0.00	0.00	0.00	0.00	0.00
8.3. In thermal pow er plants	16.59	0.00	0.00	0.51	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	15.05	0.00	0.00	0.00
8.4. In dual purpose pow er plants	14.84	0.71	0.00	0.00	0.00	0.00	0.60	9.81	0.00	0.00	0.00	0.11	0.00	0.02	3.50	0.00	0.05	0.00	0.04	0.00
8.5. In district heating plants	14.45	0.00	0.00	0.01	0.00	0.00	5.47	4.16	0.00	0.00	0.00	0.48	0.00	0.25	0.00	0.00	0.48	0.00	3.56	0.03
8.6. In hydropow er plants	471.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	471.30	0.00	0.00
8.7. Other conversion	10.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.75	0.00	0.00	0.00	0.00	0.00	0.00
1.2. Production of derived energy bearers	1270.35	0.00	0.00	3.75	7.42	0.00	1.10	4.16	0.00	256.01	38.82	318.22	67.71	23.05	33.46	11.21	0.00	0.00	483.26	22.37
9. Consumption by energy sector	237.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	11.94	0.00	0.13	17.47	11.21	166.93	0.00	29.58	0.04
9.1.1 Crude petroleum and natural gas production	182.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.60	0.00	0.00	0.00	0.00	148.71	0.00	22.39	0.00
9.1.2 Natural gas w hich is flared off on oil fields	18.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.21	0.00	0.00	0.00
9.2. Coal mines	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00
9.3. Petroleum refineries	30.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.13	17.47	11.21	0.00	0.00	2.00	0.00
9.4. Pumping storage pow er plants	2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.80	0.00
9.5. Hydro electric pow er plants	2.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
9.6. Thermal pow er plants	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
9.7. Combined heat and pow er plants	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.14	0.00
9.8. District heating plants	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.04
9.9. Gas supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Losses in transport and distribution	45.79	0.00	0.00	0.19	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47	0.00	0.58	0.00	38.60	4.68
11. Statistical differences (7-8+1.2-9-10-13.1)	167.65	-1.79	1.61	-0.07	1.08	0.00	0.02	0.00	69.96	31.10	1.66	20.61	-11.85	13.54	0.00	0.00	41.73	0.00	0.00	0.00
				0.00		0.00	0.00	0.00					0.00		0.00	0.00				
13.1 Net domestic consumption including non-energy use	857.45	20.39	7.71	3.11	18.52	22.02	19.51	5.73	0.00	41.80	20.18	186.52	2.79	49.10	11.03	0.00	38.30	0.00	393.37	17.62
13. Net domestic consumption	775.65	18.00	7.71	3.11	0.78	22.02	19.51	5.73	0.00	41.80	20.18	186.52	2.79	7.44	11.03	0.00	18.30	0.00	393.37	17.62
14. Manufacturing, mining and quarrying	240.20	17.99	7.63	3.11	0.78	0.00	12.49	5.57	0.00	0.00	0.04	9.18	0.77	5.74	11.03	0.00	12.22	0.00	151.93	1.97
14.1. Mining and quarrying	5.47	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.01	3.03	0.00	0.07	0.00	0.00	0.17	0.00	2.13	0.01
14.2. Manufacture of paper and paper products	21.25	0.00	0.00	0.00	0.00	0.00	6.85	0.56	0.00	0.00	0.00	0.07	0.69	0.04	0.00	0.00	0.35	0.00	12.43	0.26
14.3. Manufacture of industrial chemicals	54.99	7.28	1.82	0.75	0.00	0.00	1.53	0.64	0.00	0.00	0.00	0.41	0.08	1.56	11.03	0.00	4.49	0.00	24.75	0.47
14.4. Manufacture of iron, steel and ferro alloys	33.23	7.51	5.44	2.16	0.30	0.00	0.08	0.00	0.00	0.00	0.00	0.29	0.00	0.04	0.00	0.00	0.05	0.00	17.63	0.01
14.5. Manufacture of aluminium and other non-ferrous metals	71.62	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.51	0.00	0.00	1.53	0.00	69.23	0.03
14.6. Other manufacturing industries	53.62	3.19	0.37	0.20	0.39	0.00	3.99	4.37	0.00	0.00	0.02	5.15	0.00	3.52	0.00	0.00	5.64	0.00	25.75	1.20
15. Transport	207.35	0.00	0.00	0.00	0.00	0.00	5.28	0.00	0.00	40.79	16.82	136.11	1.40	0.08	0.00	0.00	4.32	0.00	2.54	0.00
15.1. Railw ays and subw ays	3.18	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00	0.00	2.54	0.00
15.2. Air transport	16.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	16.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.3. Road transport	153.18	0.00	0.00	0.00	0.00	0.00	5.25	0.00	0.00	39.02	0.00	108.24	0.00	0.08	0.00	0.00	0.59	0.00	0.00	0.00
15.4. Coastal shipping	34.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72	0.00	27.26	1.40	0.00	0.00	0.00	3.73	0.00	0.00	0.00
16. Other sectors	328.10	0.01	0.08	0.00	0.00	22.02	1.74	0.16	0.00	1.01	3.33	41.23	0.62	1.61	0.00	0.00	1.76	0.00	238.90	15.65
16.1. Fishing	19.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.01	17.54	0.62	0.00	0.00	0.00	0.00	0.00	0.72	0.00
16.2. Agriculture	13.85	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.01	0.01	5.56	0.00	0.00	0.00	0.00	0.64	0.00	7.42	0.02
16.3. Households	164.94	0.01	0.01	0.00	0.00	22.02	0.00	0.00	0.00	0.72	1.67	2.67	0.00	0.36	0.00	0.00	0.16	0.00	133.44	3.90
16.4. Other consumers	118.49	0.00	0.07	0.00	0.00	0.00	1.26	0.16	0.00	0.02	1.63	9.57	0.00	0.36	0.00	0.00	0.94	0.00	92.75	11.74
16.5 Construction	11.69	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.02	0.01	5.89	0.00	0.89	0.00	0.00	0.03	0.00	4.58	0.00
12. Consumption for non-energy purposes	81.80	2.39	0.00	0.00	17.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.66	0.00	0.00	20.00	0.00	0.00	0.00
12.1 Manufacture of industrial chemicals	62.31	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.60	0.00	0.00	20.00	0.00	0.00	0.00
12.2 Other manufacturing	19.49	2.39	0.00	0.00	17.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00

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 to 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 AIV-1 below:

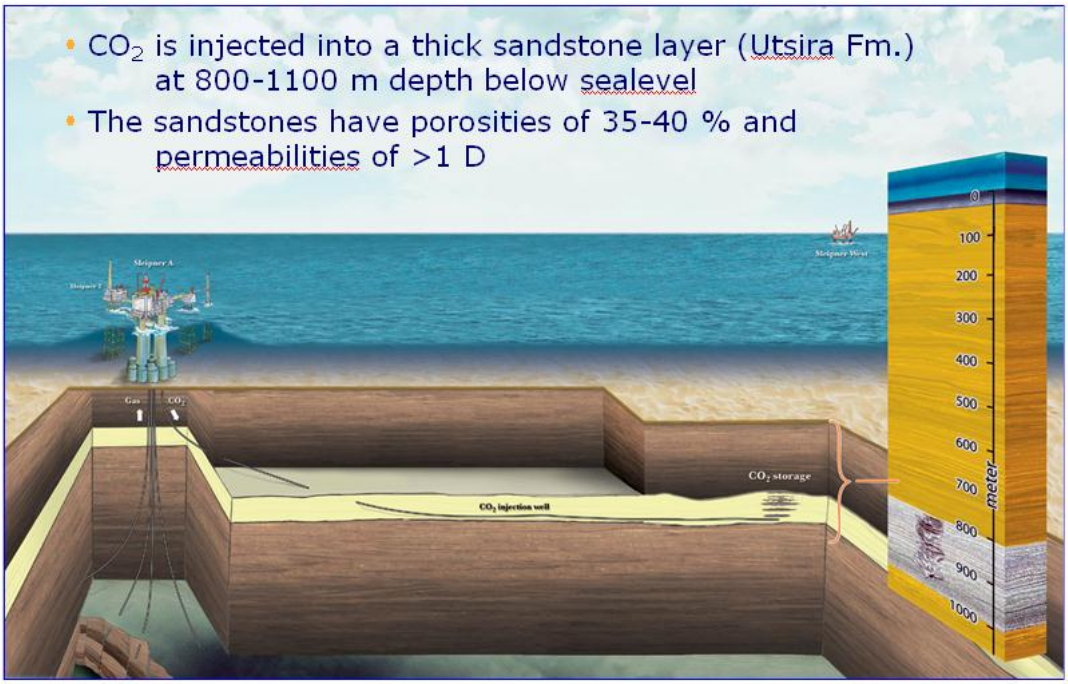

Figure AIV- 1 CO_2 capture at Sleipner Vest and storage at Sleipner Øst

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.

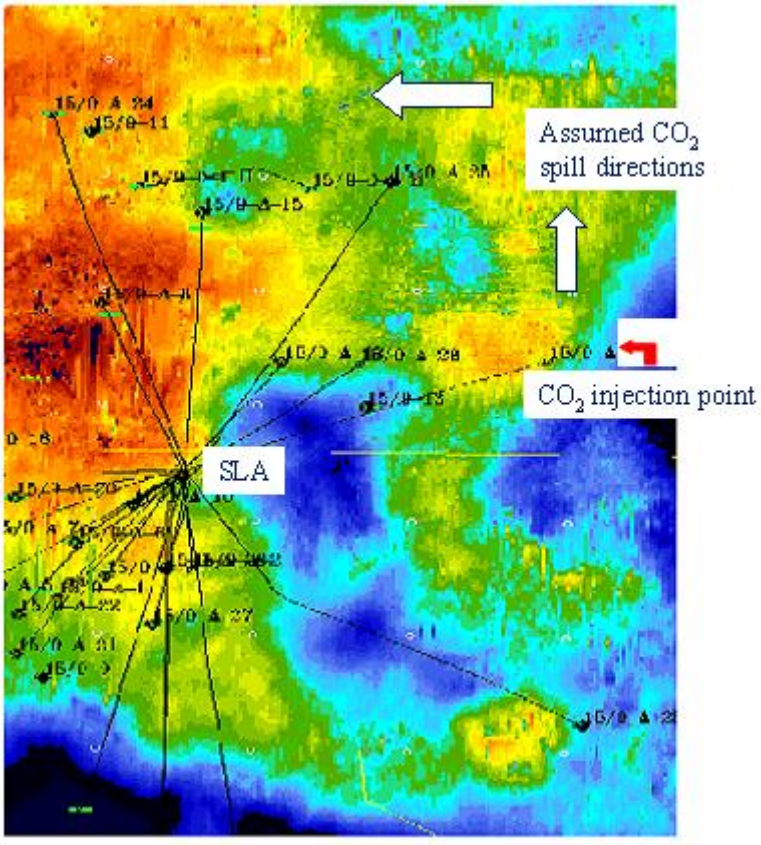

Figure AIV- 2 Position of CO_2 injection point and expected migration direction of CO_2 Sleipner field.

1.2 Applied methods for monitoring the injected CO2

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, 2010 and 2013

b) Gravimetric monitoring:

- Pre-installed 30 concrete benchmarks in 2002 across the CO_2 bubble
- Repeat survey 2005 and 2013.

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

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).

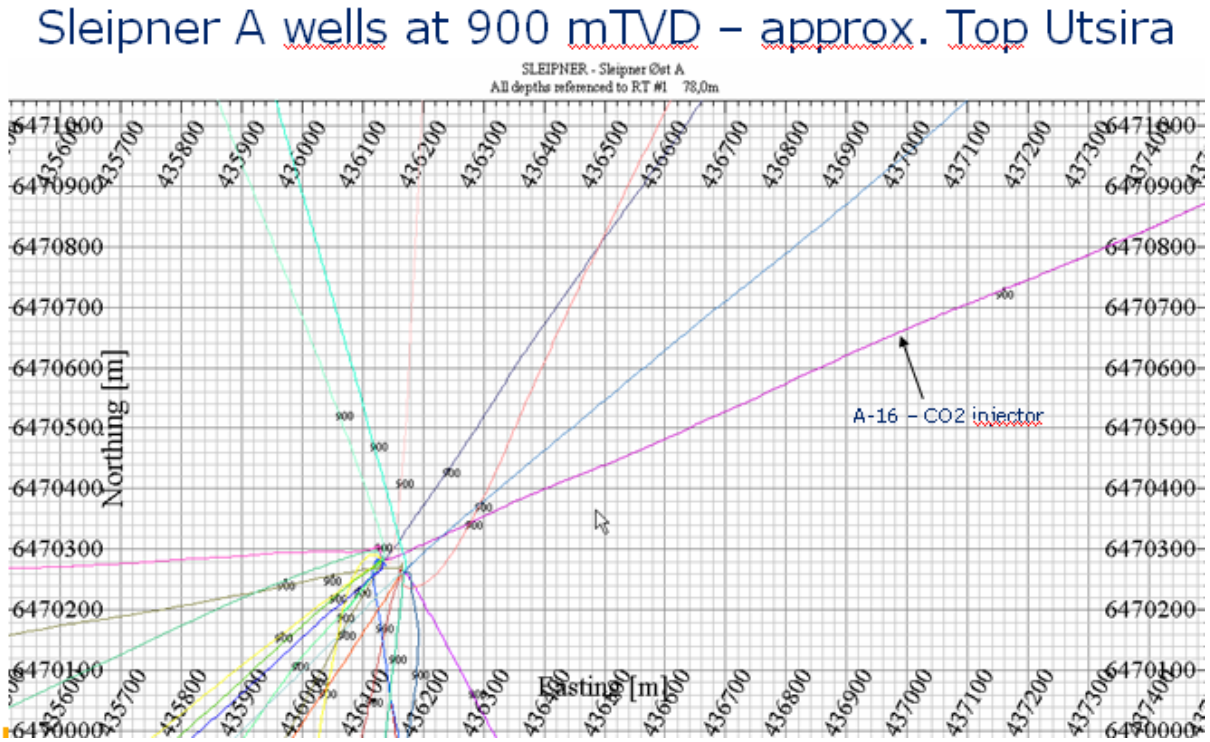

Figure AIV- 3 Positions of Sleipner production wells relative to the CO_2 injection well.

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

a) 4-D seismic

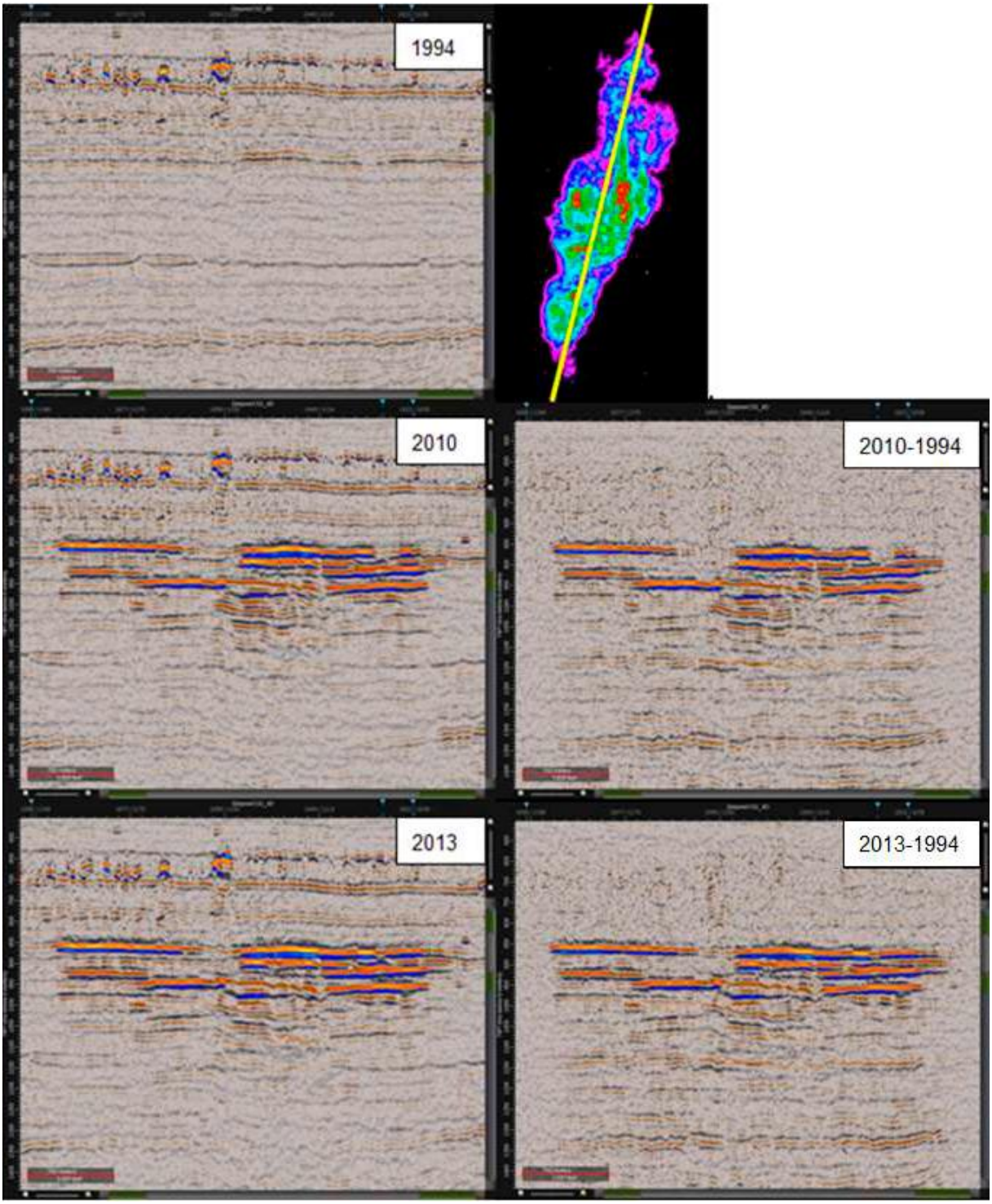

Figure AIV- 4 Results of seismic monitoring 1994 – 2013.Seismic section shown on the upper right figure.

The figure above is based on seismic data from 1994 – 2013.

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, 2008 and 2013.

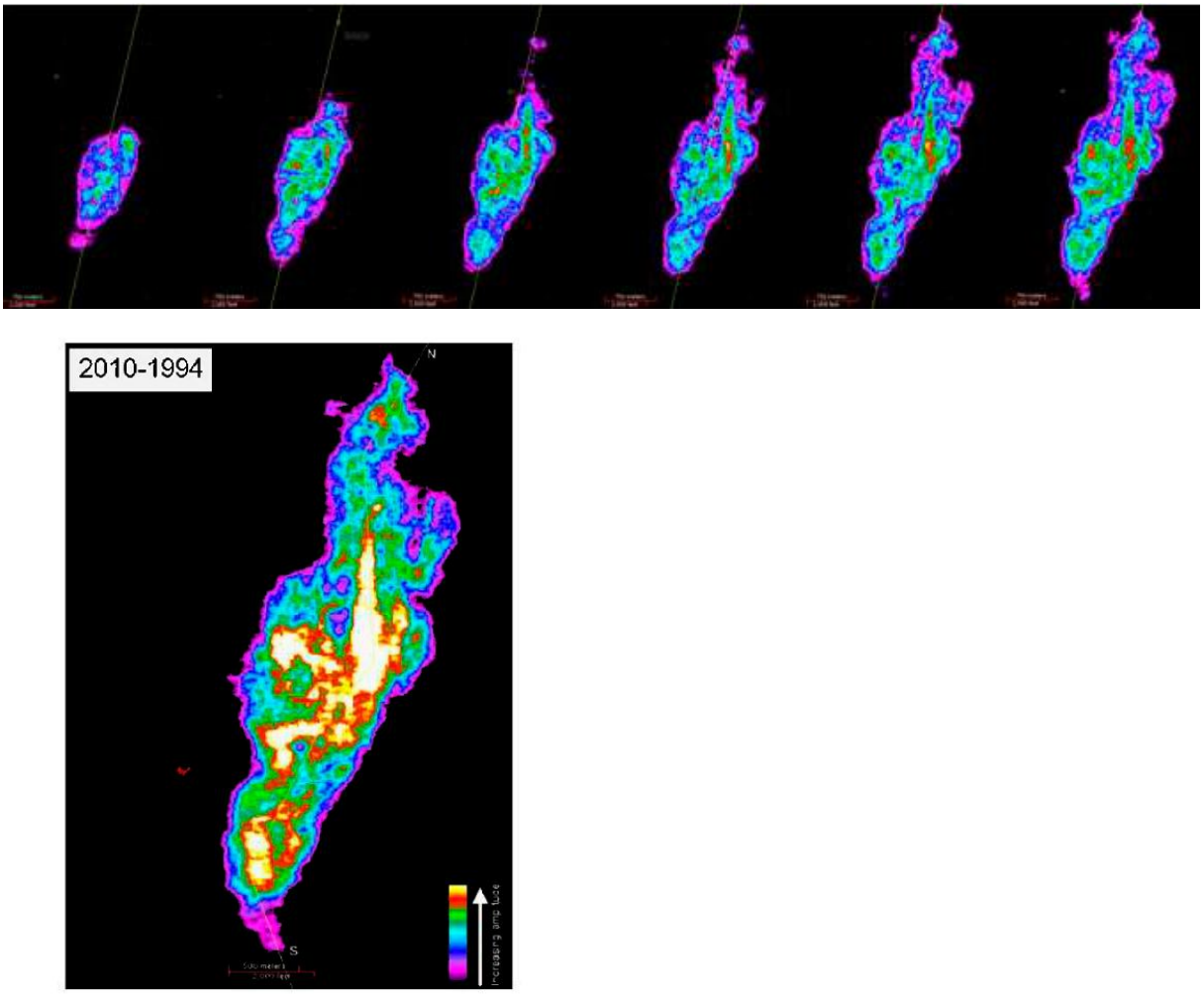

Figure AIV- 5 CO_2 plume extension in 1999 to 2008 and the last figure showing cumulative amplitude from 4D seismic. The differences in amplitudes reflect the cumulative thickness of the CO_2 layers.

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.

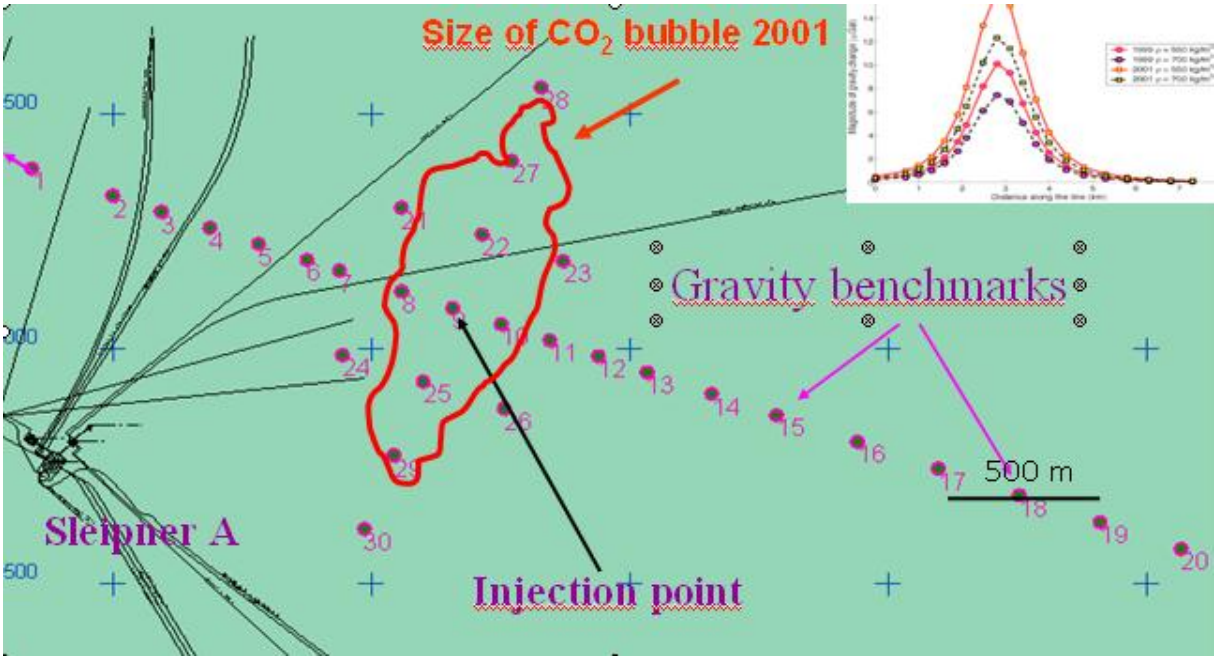

Figure AIV- 6 Gravimetric monitoring.

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.

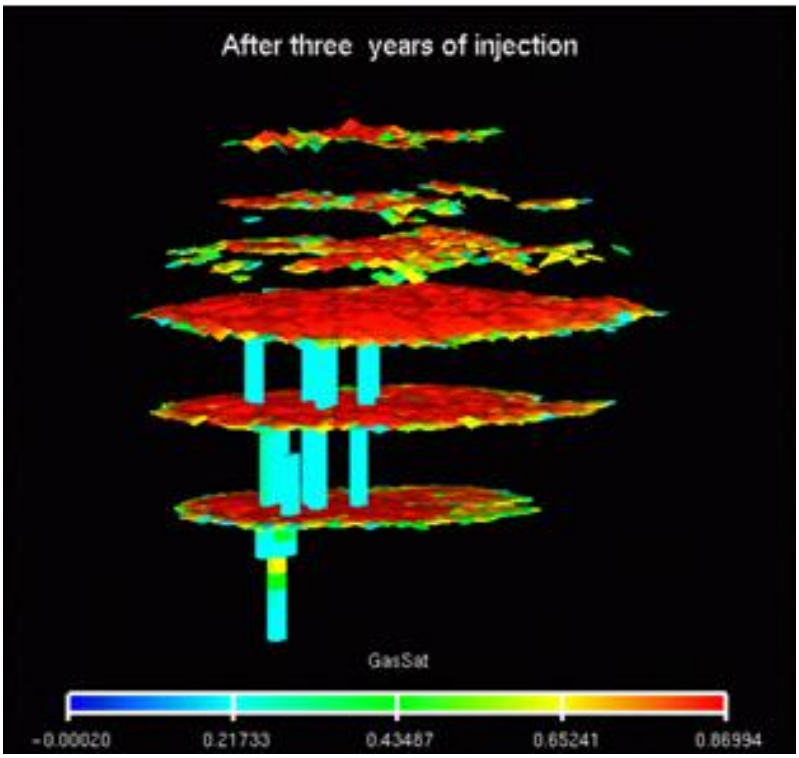

Figure AIV- 7 Flow simulation of CO_2.

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.

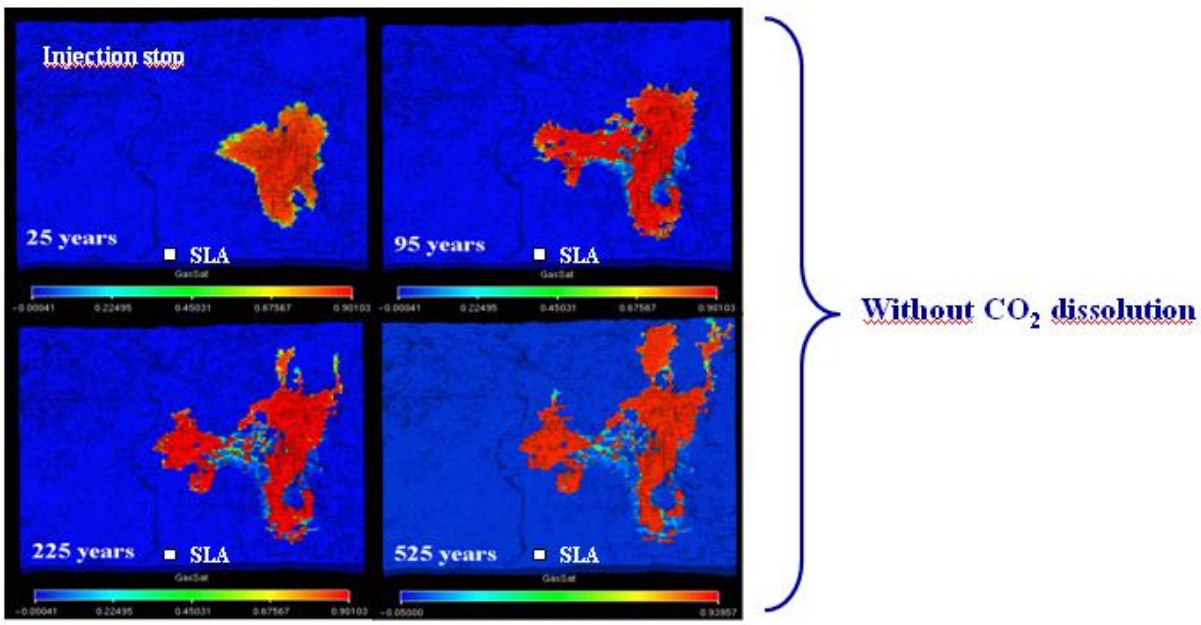

Figure AIV- 8 Simulation results seen from above without taking into account the effect of CO_2 dissolution.

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 to the CO_2 plume.

1.4 Publications and conference presentations

1.4.1 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.

1.4.2 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)

1.4.3 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

1.4.4 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 CO2 re-injection system and well specification:

2.1.1 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 AIV- 9*). The injection pipeline is 152 km long (Figure AIV- 10).

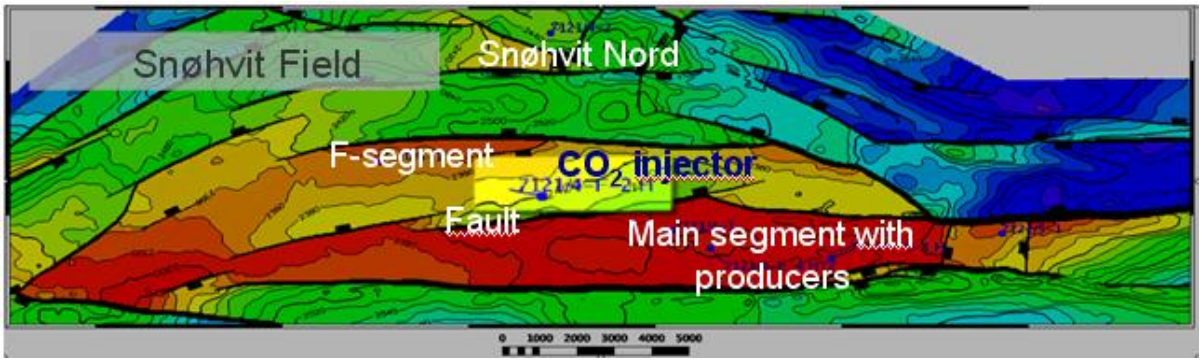

Figure AIV- 9 Location of the CO2 well at Snøhvit.

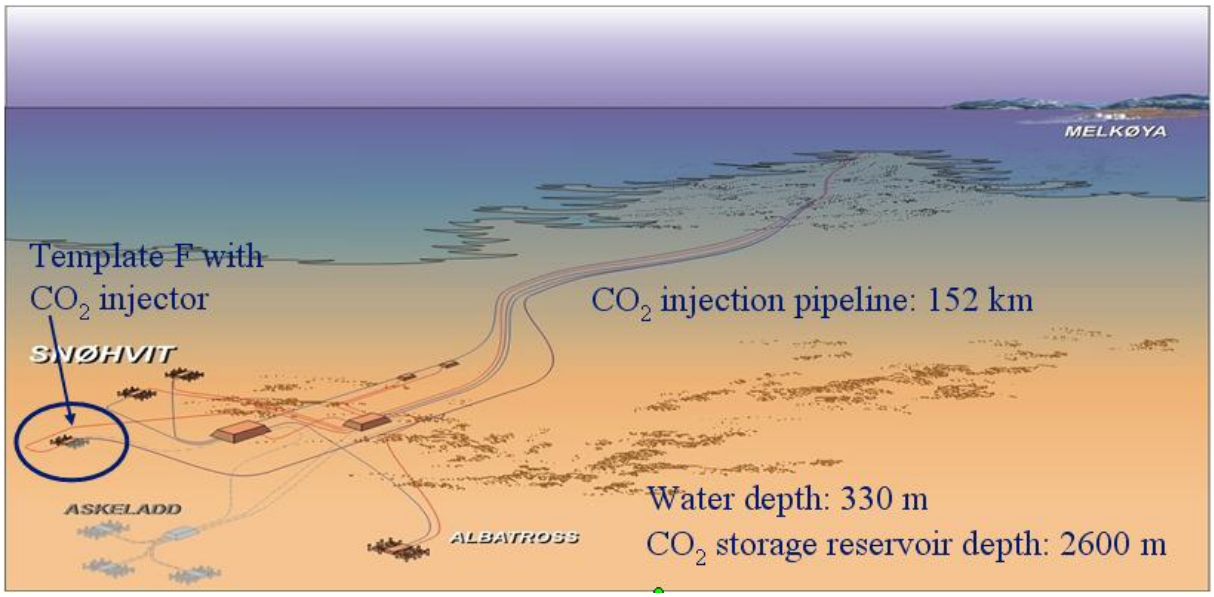

Figure AIV- 10 Field overview.

Table AIV- 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 AIV- 11. If injection fails, additional perforations could be added in Tubåen, and/or bottom of Stø could be opened up for injection.

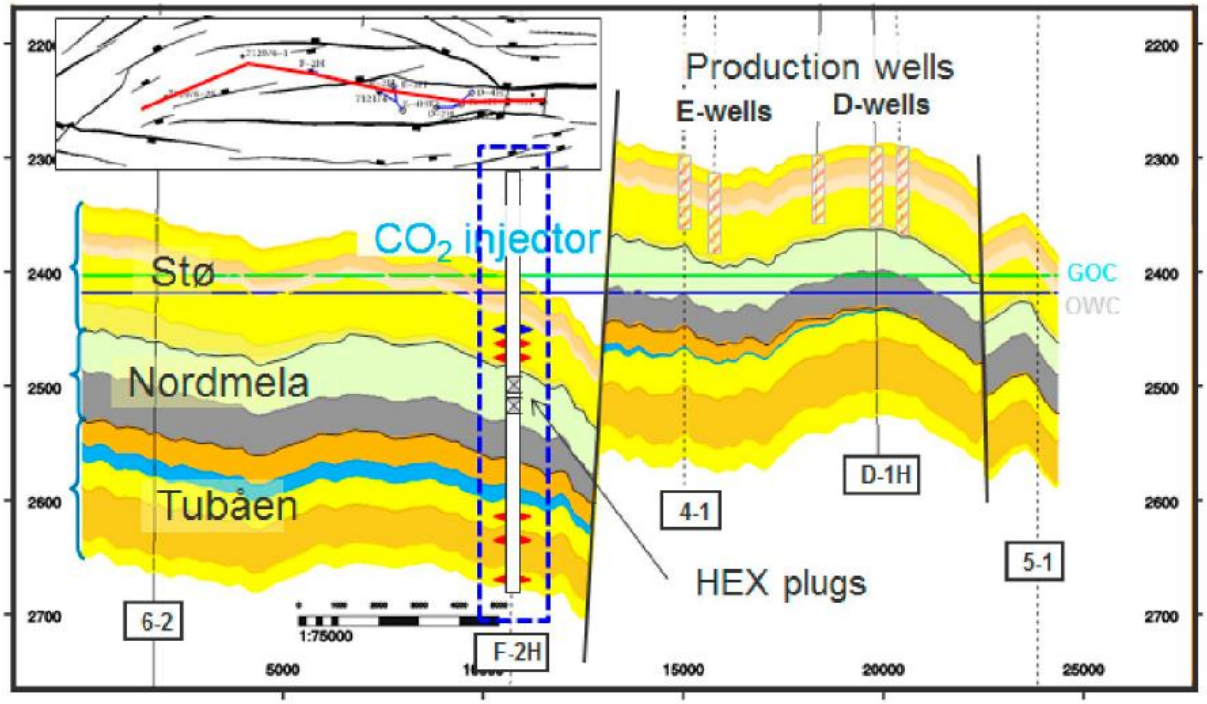

Figure AIV- 11 Cross-section of F-segment where CO2 is injected.

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 AIV- 12. The indicated physical and measured values are expected initial values. Figure AIV- 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 AIV- 13.

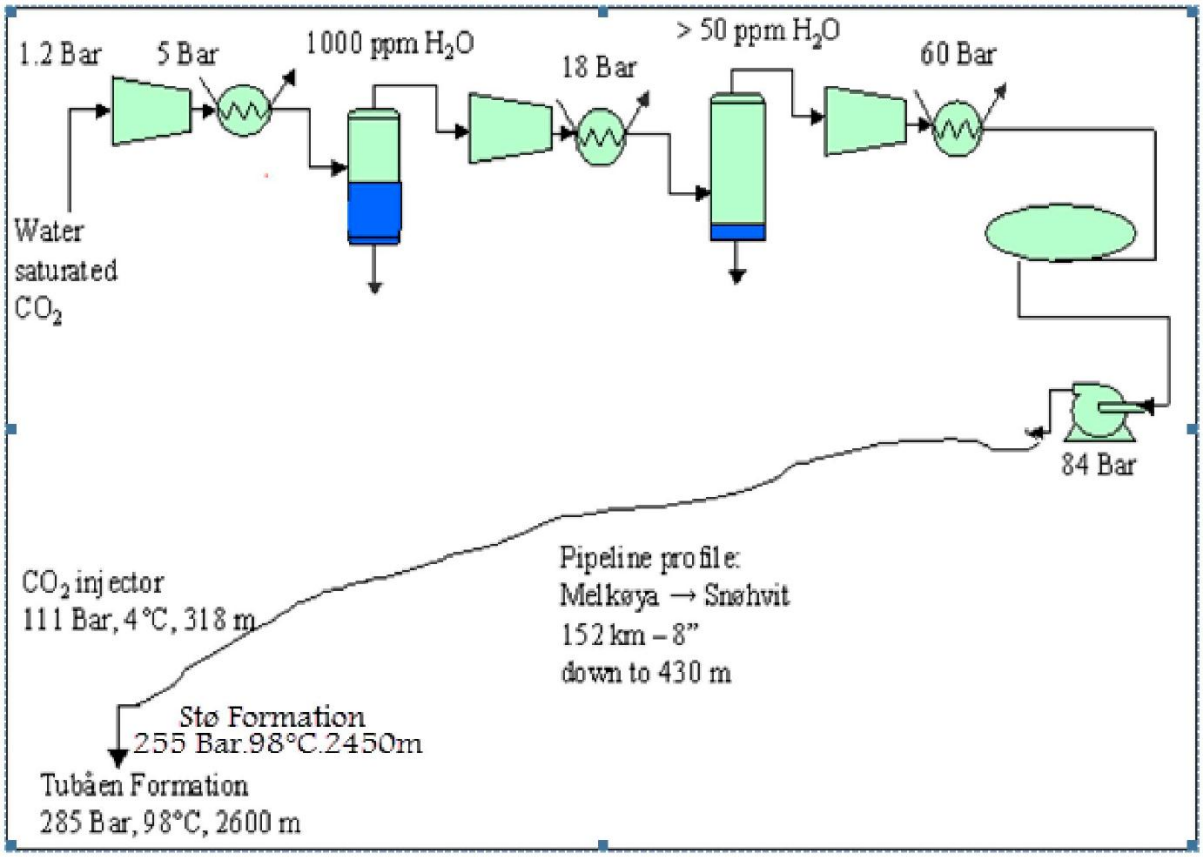

Figure AIV- 12 Schematic of the CO2 injection system.

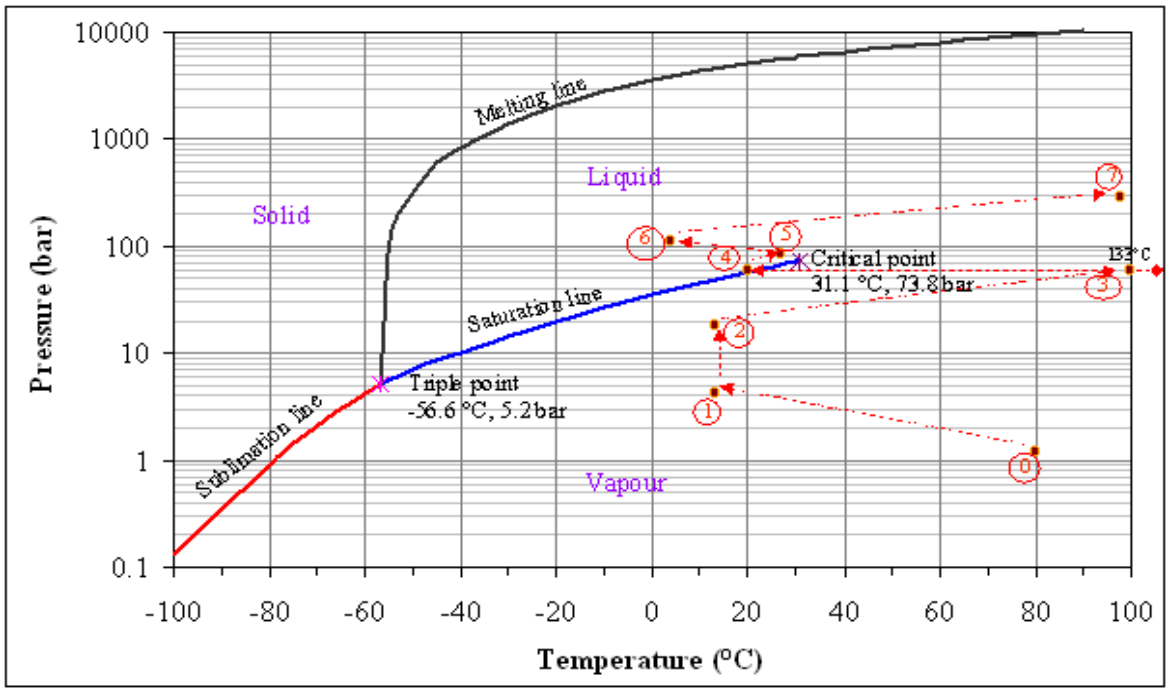

Figure AIV- 13 CO2 phase diagram with eight phase conditions identified in the injection system in the Snøhvit area.

The figures (Figure AIV- 12 and Figure AIV- 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).

2.1.2 CO_2 well stream specification

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

2.1.3 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 CO2

a) Seismic monitoring

- 3D seismic shot in 2003
- 2D line shot in 2006
- 3D/4D seismic monitoring survey in 2009, 2011 and 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 AIV- 14.

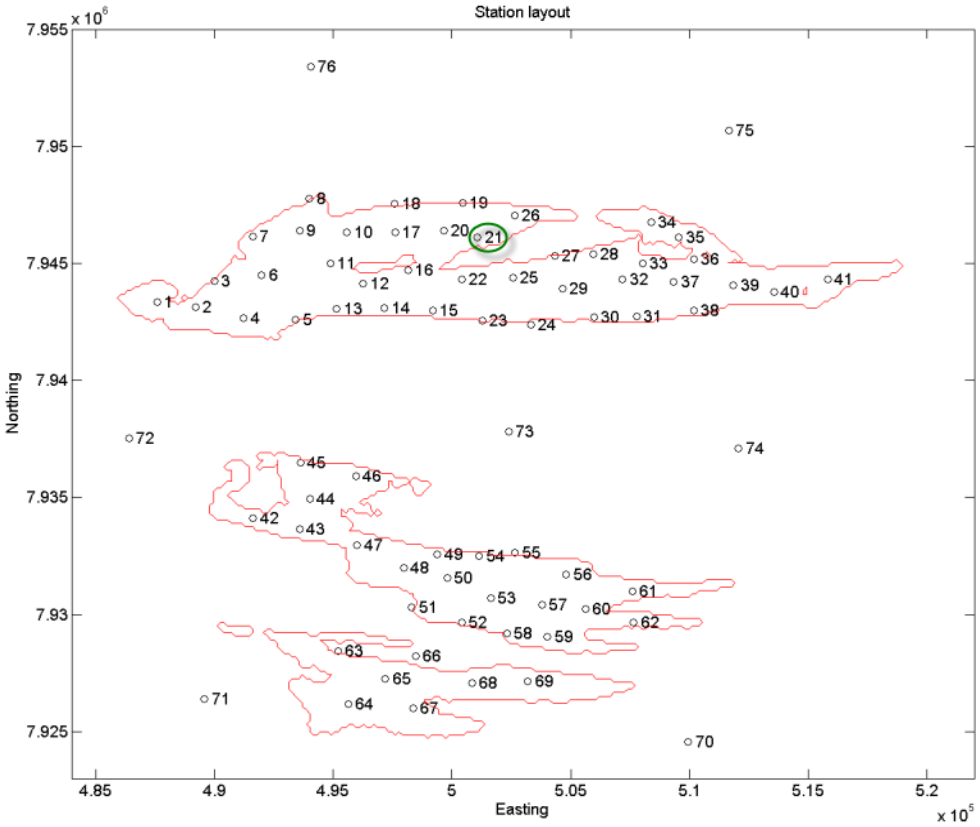

Figure AIV- 14 Benchmarks Gravimetric monitoring CO2 storage in the Snøhvit area.

c) Pressure measurements

Pressure and temperature gauge is installed in the well 600 metres above top reservoir and the pressure development in the injection well F-2 H is monitored on a daily basis. Actual bottom hole pressure is estimated based on gauge measurements and CO_2 pressure, volume and temperature properties. 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

Date	Version	Performed by	Comment
Nov 2006	1	Norwegian Pollution Control Authority	Part of the initial report 2006
15.04.2010	2	Climate and Pollution Agency	Updates for 2010 submission
25.05.2012	3	Climate and Pollution Agency	Updates for 2012 submission
10.04.2013	4	Climate and Pollution Agency	Updates for 2013 submission
21.03.2014	5	Norwegian Environment Agency	Updates for 2014 submission
1.11.2015	6	Norwegian Environment Agency Norwegian Institute of Bioeconomy Research Statistics Norway	Revision/updates for 2015 Submission

Version 6

2015

Contents

Preface

According to the decision on Article 5.1 of the Kyoto Protocol all Annex 1 parties that also are Parties to the Kyoto Protocol, 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 the national system was reported as part of a Party's Initial Report to the Kyoto Protocol in line with decision 13/CMP.1. The purpose of the Initial Report was to facilitate the calculation of assigned amount and demonstrate the capacity to account for emissions, removals and assigned amount. Norway's Initial Report was submitted to the Climate Convention in December 2006 and the report on the national system for greenhouse gas inventories was attached to the Initial Report as an appendix.

The report on national system for greenhouse gas inventories was prepared by a project team consisting of representatives from the Norwegian Environment Agency, Statistics Norway, the Center for International Climate and Environmental Research – Oslo (CICERO) and The Norwegian Institute of Bioeconomy Research (formerly The Norwegian Forest and Landscape Institute). Norway's national system has changed over the years, and the changes have been reported annually in the National Inventory Reports.

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]/CMP[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 *specific 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 CMP 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] The Conference of the Parties serving as the meeting of the 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 IPCC Guidelines as elaborated by the IPCC good practice guidance[4]
    - 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), the IPCC Good Practice Guidance for Uncertainty Management in National Greenhouse Gas Inventories from 2000 (IPCC, 2000) and in the 2006 IPCC guidelines for national greenhouse gas inventories (IPCC, 2006). For the land use, land-use change and forestry (LULUCF) sector, the IPCC has prepared a supplementary good practice report in 2004 (IPCC, 2004).

[4] The draft decisions on the implications of the implementation of decisions 2/CMP.7 to 4/CMP.7 and 1/CMP.8 on the previous decisions on methodological issues related to the Kyoto Protocol, including those relating to Articles 5, 7 and 8 of the Kyoto Protocol were not adopted at CMP.10 in Lima. In these draft decisions, reference is made to the 2006 IPCC guidelines.

The Parties to the UN Framework Convention on Climate Change (UNFCCC) have through decision 24/CP.19 agreed on revised guidelines for reporting data on emissions and removals, building on the guidance from the IPCC. 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.

Decision 24/CP.19 also states that Annex I parties under the Convention should design and operate national inventory arrangements. The national inventory arrangements are similar to the national system of the Kyoto Protocol. This report's description of the functions required for the national system is also a description of the national inventory arrangements in Norway.

2 National responsibilities

2.1 General overview

The Norwegian national system for greenhouse gas inventories is based on cooperation between the Norwegian Environment Agency (the national entity), Statistics Norway and the Norwegian Institute of Bioeconomy Research. Statistics Norway is responsible for the official statistics on emissions to air, including a greenhouse gas inventory.

In accordance with the decision on Article 5.1 of the Kyoto Protocol a new formalized agreement was signed between the three core institutions that ensures the continuation of the national system for greenhouse gas inventories and reporting for the period from 2015 – 2022.

The Norwegian Institute of Bioeconomy Research is responsible for the calculations of emission and removals from Land Use and Land Use Change and Forestry – LULUCF and for KP-LULUCF.

The reporting to the UNFCCC is based on the greenhouse gas inventory and the LULUCF calculations.

2.2 Institutional cooperation, responsibilities and agreements

The three core institutions, the Norwegian Environment Agency, Statistics Norway and The Norwegian Institute of Bioeconomy Research, 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 AV-1.*

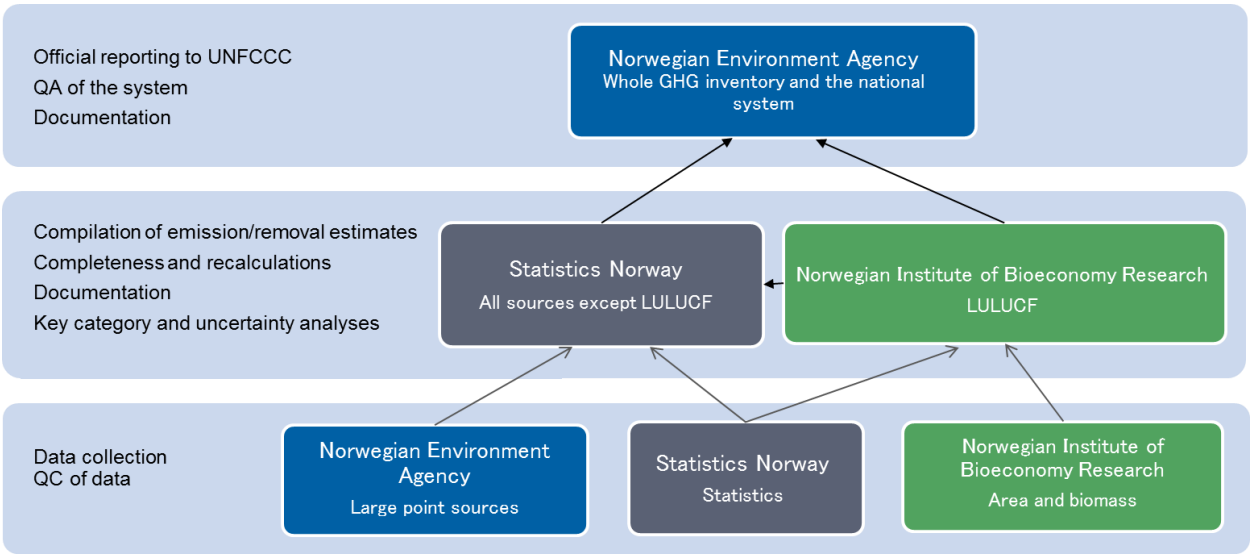

Figure AV- 1. Overview of participating institutions, institutional responsibilities and cooperation

To ensure that the institutions comply with their responsibilities, Statistics Norway and The Norwegian Institute of Bioeconomy Research have signed agreements[5] with the Norwegian Environment Agency as a national entity. The Forest and Landscape Institute's obligations will also be guided by an 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.[6]

The establishment of the national system requires close collaboration between the three institutions. The Norwegian Environment Agency as a national entity is responsible for preparing, organizing and reporting meetings between the three institutions. 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. Normally, two cooperation meetings are held every year. The cooperation meeting makes 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.

[5]New, formalized agreements have been made in 2014 between the Norwegian Environment Agency and Statistics Norway and the Norwegian Environment Agency and The Norwegian Institute of Bioeconomy Research which regulates details about the cooperation within the national system

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

Most key data are collected by the three core institutions, as shown in Annex 5. Additional key data providers include the Norwegian Petroleum Directorate, the Norwegian Petroleum Industry Association, and the Norwegian Road Federation.

2.3 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 Norwegian Environment Agency is a government institution. Their responsibility for the national system is described in the annual letter from the Ministry of Climate and Environment where they give directions on the Norwegian Environment Agency's key priorities and financial resources for the following year. The national system involves several units in the Norwegian Environment Agency. To ensure that the requirements are met, the Section for Emission Inventories and Analysis holds the main responsibility and coordinating role in the Agency.

Statistics Norway is an independent government institution. The production of the emission inventory has up till now been a 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 Norwegian Environment Agency.

The Norwegian Institute of Bioeconomy Research 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 Institute of Bioeconomy Research through its funding over the government budget and partly through specific project funding from the Norwegian Environment 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.

The three core 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 are 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.

2.4 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 Norwegian Environment Agency the authority to collect and review emission data from large industrial plants (https://lovdata.no/dokument/NL/lov/1981-03-13-6?q=forurensningsloven, http://www.regjeringen.no/en/doc/laws/acts/pollution-control-act.html?id=171893). Emissions of 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. Collection and checking of GHG emission data are also covered by the *Greenhouse Gas Emission Trading Act* (https://lovdata.no/dokument/NL/lov/2004-12-17-99?q=klimakvoteloven, http://www.regjeringen.no/en/doc/laws/acts/greenhouse-gas-emission-trading-act.html?id=172242). The implementation rules are stipulated in a regulation (https://lovdata.no/dokument/SF/forskrift/2004-12-23-1851?q=klimakvote) Statistics Norway is a professional independent institution, which through The Statistics Act (https://lovdata.no/dokument/NL/lov/1989-06-16-54?q=statistikkloven) 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.

2.5 The Norwegian Environment Agency's responsibilities as national entity

The Norwegian Environment Agency has been appointed by the Ministry of Climate and Environment as the national entity through the budget proposition to the Norwegian parliament (Stortinget) for 2015, which states that "*The Norwegian system will build on existing organization and cooperation between the Norwegian Environment Agency, Statistics Norway and the Norwegian Institute of Bioeconomy Research. These three institutions are held individually responsible that their own contributions to the national system are in line with the guidelines from the Climate convention on the calculation and archiving of emissions and removals of greenhouse gases. The Norwegian Environment Agency is still appointed as a national entity with overall responsibility for the inventory and reporting*". (St. prop. Nr. 1 (2014-2015)). This point of the proposition has been accepted by

the Norwegian parliament without any remarks. The Norwegian Environment Agency as a national entity is 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 a 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 Climate and Environment, The Ministry of Agriculture and Food and the Ministry of Finance.

2.6 Official consideration and approval of the inventory

The Norwegian Environment 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 Norwegian Environment Agency will consider the completion of the inventory and the National Inventory Report. The Norwegian Environment Agency will also review:

- The QA/QC report from the QA/QC responsible in the Norwegian Environment 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

2.7 Inventory production plan

The core institutions have agreed on a “milestone” production plan (Table AV- 1). The plan will be supplemented by internal production plans in the three core institutions. For the 2015 NIR, the milestones of the inventory reporting cycle have not been according to the production plan, primarily because of challenges with the CRF reporting tool. The production plan will be revised for the 2016 NIR to account for new production routines arising from the new CRF reporting tool.

Table AV- 1 Inventory production plan, milestones (indicative dates) For the reporting year 2015, the deadlines regarding the CRF will be postponed due to delays in the CRF reporting tool.

	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	Norwegian Environment Agency	Feb. 1st
Agreement on major methodological changes needed for next year's reporting	All	May 15th
Preliminary emissions data from plants sent to Statistics Norway	Norwegian Environment Agency	April 15th
Final emissions from large industrial plants sent to Statistics Norway	Norwegian Environment Agency	Oct. 15th
LULUCF area data collection for the previous calendar year completed	Institute of Bioeconomy Research	Dec. 1st
All non-LULUCF data collection completed	Statistics Norway	Nov. 1st
National publishing of inventory	Statistics Norway	December
LULUCF inventory is completed and entered into the online CRF portal.	Institute of Bioeconomy Research	Feb. 15th
Test runs, QA/QC (excluding LULUCF)	Statistics Norway	Nov. 15th
Draft inventory to Norwegian Environment Agency for comments and QA/QC (excluding LULUCF)	Statistics Norway	Dec. 15th
Final inventory including completion of QA/QC tests and recalculations (excluding LULUCF)	Statistics Norway	Jan. 15th
Review of documentation and necessary updates made[1]	All	Feb. 1st
NIR first draft	Norwegian Institute of Bioeconomy Research and Norwegian Environment Agency	March 1st

Completion of CRF tables	Statistics Norway and Institute of Bioeconomy Research	March 15th
QA/QC reports sent to the Norwegian Environment Agency	All	March 20th
QC routines in the CRF reporter performed	Norwegian Environment Agency	April 1st
NIR finalized	Norwegian Environment Agency	April 13th
QA/QC report finalized	Norwegian Environment Agency	April 13th
Formal approval of inventory for the purpose of reporting	Norwegian Environment Agency	April 13th
Reporting	Norwegian Environment Agency	April 15th

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

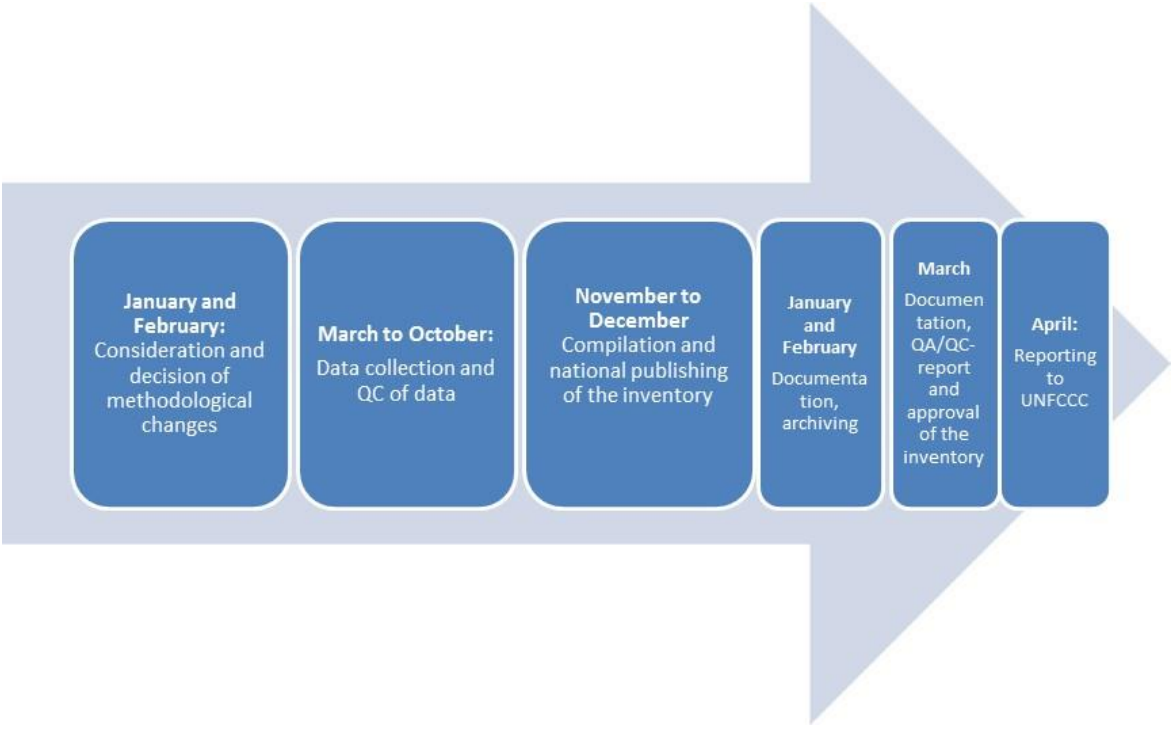

Figure AV- 2 The inventory preparation cycle

3 QA/QC-plan

3.1 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 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.

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

- 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.

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.
- Regular evaluation assessing potentially 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 over- 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.

3.2 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 on method implementation and of data originally collected by another institution in addition to reviewing the QC performed on these data by the institution collecting the data.

The Norwegian Environment Agency as the national entity is responsible for overall QC and in charge of checking that the appropriate QC procedures are implemented internally at the Norwegian Environment Agency, Statistics Norway, and the Norwegian Institute of Bioeconomy Research. Statistics Norway has an overall responsibility for QC of the data of the emission inventory, including the estimate of total emissions. The Norwegian Environment Agency checks the QC reports and may request Statistics Norway to revise the inventory if the QC report is not satisfactory, if errors in the inventory are identified, or if any of the methodologies used are not as agreed by the cooperation meeting. In the case of a disagreement between the Norwegian Environment Agency and Statistics Norway on any numbers in the emission inventory, the Norwegian Environment 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 annual reporting on their completion of the QC procedures before the inventory submission to the UNFCCC. The reporting is based on a general and a source-specific QC checklist and a textual description of possible recalculations, issues to be followed up before the next submissions and other relevant information. The QC reports are sent to the Norwegian Environment Agency.

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

3.3 QC procedures

The input data used in the Norwegian national inventory are classified as emission factors, model 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 6 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 1 (IPCC, 2006) gives guidance on QC.

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

3.3.1 General QC procedures

The general QC procedures are performed annually for all data collected and all estimated data. For all sectors except LULUCF, 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. For the LULUCF sector, the QC checks are described in chapter 6 of the NIR.

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 and IPPU 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[8] reporting. Up to now the comparison has been performed for national source categories.

The general checks for the three institutions are summarized in Table AV- 2.

[8] Nomenclature for reporting of air pollution data to UNECE.

Table AV- 2 General annual QC checks for the Norwegian Environment Agency (Acronyms; SN: Statistics Norway, NIBIO: The Norwegian Institute of Bioeconomy Research)

	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 Norwegian Environment Agency
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 SN.	The Norwegian Environment Agency
Consistency checks		
	Checks for time-series consistency in cases where emissions from plants collected by the Norwegian Environment Agency only are available for parts of the time-series.	SN + The Norwegian Environment Agency
	Checks for time-series consistency where activity data are only available on a non-annual or cyclical basis.	NIBIO (SN and The Norwegian Environment Agency)
	IEF checks of input data: Checking derived emission factors for individual plants (reported emissions divided by energy consumption, production or other activity data), flagging plants whose IEFs deviate significantly from the default values for further investigation. The investigation of flagged observations is prioritized based on magnitude of emissions and deviation from default IEFs, focusing on correcting obvious errors.	SN, The Norwegian Environment 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 (NIBIO in particular)
	Check that when recalculations are performed these are made consistently throughout the time-series.	All

	Check	Responsible
	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

Table AV- 3 General annual QC checks for Statistics Norway

	Check	Responsible
Time-series and inventory version comparisons to detect problems with units, computational errors as well as other human errors.		
	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.	SN
	Time series check of emissions, 1: Compare all estimated emissions for the latest inventory year to those of previous inventory year at the level of IPCC reporting and flag changes of more than 50 % for further QC.[9]	SN
	Time series check of emissions, 2: Compare all estimated emissions **for the latest year in the time series** 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]	SN
	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.	SN

[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.

	Check	**Responsible**
	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.	SN
Completeness checks		
	Check that aggregate energy use in the emission model reflect the most recent energy balance.	SN
	Check the difference between estimated fuel use for road transport with fuel sales.	SN
	Flag incomplete categories through use of the emission model and data reported for previous years. Empty cells are subject to additional checks.	SN
	Check that all cells with energy consumption have a corresponding emission factor.	SN
	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.	SN
	Check for completeness/double-counting between the LULUCF inventory and the inventory of other sources.	SN
Consistency checks		
	Comparison of emissions in the main emission model with totals estimated in sub-model (e.g. road transport and waste models).	SN
	Check for consistency where the same data are used in more than one category (SN). The emission model of SN is designed to avoid duplicating data by entering of the same data only once. This check also includes consistency checks between data used by the Norwegian Environment Agency and the Norwegian Institute of Bioeconomy Research with data used for the other categories.	SN
	Checks for time-series consistency in cases where emissions from plants collected by the Norwegian Environment Agency only are available for parts of the time-series.	SN + The Norwegian Environment

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

	Check	**Responsible**
		Agency
	Checks for time-series consistency where activity data are only available on a non-annual or cyclical basis.	NIBIO (SN and The Norwegian Environment Agency)
	IEF checks of input data: Checking derived emission factors for individual plants (reported emissions divided by energy consumption), flagging plants whose IEFs deviate significantly from the default values for further investigation. The investigation of flagged observations is prioritized based on magnitude of emissions and deviation from default IEFs, focusing on correcting obvious errors.	SN, The Norwegian Environment Agency
	IEF checks of results: Checking derived emission factors at the level of reporting, singling out sources whose IEFs deviate significantly from default values. Based on the significance of the source and the level of deviation from the default IEF, sources are selected for further investigation. The focus is on the most recent years of the time series.	SN
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 (NIBIO 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

Table AV- 4 General annual QC checks for the Norwegian Institute of Bioeconomy Research

Check performer	***Type of check***
Checks for errors in time-series, units, computational and human errors	
All source-responsible	Evaluate emission from the whole time series by providing: 1) range of appropriate values, 2) red color on extraordinarily large inter-annual variation, and 3) explanation of why in the LULUCF excel sheet.
Area responsible	Analyze area changes in land use and provide a range of appropriate annual changes.
LULUCF compiler	Ensure that drastic annual changes are commented and that all reported C changes are within the range provided in the LULUCF excel sheet.
Completeness checks	
LULUCF compiler	Automated completeness is checked by Statistics Norway in the CRF reporter. NIBIO awaits the results before final CRF and NIR are approved.
LULUCF compiler	Of inclusion of all emission/removal sources.
LULUCF compiler	All LULUCF and KP tables in CRF are inspected for missing annual values.
Checks for errors in time-series, units, computational and human errors	
NIBIO & Statistics Norway	Two cross-checks with Statistics Norway: 1) areas of cultivated organic soils and 2) areas of N-fertilized forests.
Qualified NIBIO person*	Consistency check of areas reported in CRF tables for convention and KP.
Source-responsible	Living biomass in forest is used as model input for estimating C stock changes in forest soils and DOM. The biomass estimates are cross-checked.
LULUCF compiler	It is checked that the area of drained forest is used both for estimating CO_2 and N_2O emissions.
Recalculations	
LULUCF compiler	All recalculations made are described in the NIR in chapter 6 and 11 *LULUCF* and *KP-LULUCF* and repeated for LULUCF in chapter 9 *Recalculations.*
All source-responsible	Sink/source category reporters explain in the LULUCF excel sheet when recalculations have been made.
LULUCF compiler	CRF recalculations are made for 1990, 2000, and the last year of the inventory period and inspected manually. Percent changes larger than 50% are explained in the CRF reporter.
Documentation	
LULUCF compiler	Check that new methods are described in detail and that the documentation is stored properly and can be made available upon request during review.
All source-responsible	Store all source/sink specific information on:

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** This person is not directly involved in the reporting.*

3.3.2 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 Norwegian Environment Agency, Statistics Norway and the Norwegian Institute of Bioeconomy Research, in collaboration with other relevant authorities, as a part of the improvement plan (with the Norwegian Environment 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 Norwegian Environment Agency, Statistics Norway and The Institute of Bioeconomy Research .

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 latest 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 industrial 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 Norwegian Environment Agency, while the Norwegian Environment 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 Norwegian Environment 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 Norwegian Environment Agency, Statistics Norway, The Institute of Bioeconomy Research and/or another institution with expertise in the category subject to review. It can address a single category or several related categories (e.g. road transportation and agriculture) and will include an assessment of the emissions factors currently in use and conclude on the need for revisions.

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

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 representativeness 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 Norwegian Environment Agency, Statistics Norway and The Norwegian Institute of Bioeconomy Research for the data collected by each institution. Some activity data are originally collected by another institution. In this situation the Norwegian Environment Agency, Statistics Norway or the Norwegian Institute of Bioeconomy Research (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 representativeness, 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 (NFI)
- 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

3.3.3 CRF tables

After the implementation of reporting with the new UNFCCC CRF software, Statistics Norway and the Norwegian Institute for Bioeconomy Research transfer emission data using Excel imports. Separate datasets for activity data and notation keys have been developed. QC consistency checks are built-in features in the new CRF, and these are used actively. Statistics Norway and the Norwegian Environment Agency are 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

The Norwegian Institute of Bioeconomy Research is responsible for checking all LULUCF entries with data from its database.

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

3.3.4 NIR

The Norwegian Environment 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)

3.3.5 Timeliness

The Norwegian Environment Agency, Statistics Norway and the Norwegian Institute of Bioeconomy Research have agreed on a timetable to enable the Norwegian Environment Agency to report to UNFCCC by April 15 (see Table AV- 1). It is the responsibility of the Norwegian Environment Agency, Statistics Norway and The Institute of Bioeconomy Research 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.

3.3.6 QC documentation

The members of the inventory team working with individual sectors or parts of a sector fill in a QC checklist 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.

3.4 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.

3.4.1 Statistical data and emissions reported from plants

Emissions reported from plants

Emissions reported from industrial sites are always checked by the Norwegian Environment Agency (see section 3.3.2) by the Department in charge of evaluating emission permits. Also, the Department of Inspection and Environmental Data in the Norwegian Environment Agency, includes two units responsible for chemicals and product control, and industrial and offshore control. These sections work independently from the units responsible for the evaluating of 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 AV- 5.

Table AV- 5 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 Norwegian Environment 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 Norwegian Environment 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 Emission Inventories and analysis in the Norwegian Environment 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 Norwegian Environment Agency or Statistics Norway or The Norwegian Institute of Bioeconomy Research 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 Norwegian Environment Agency, and deviations are explained through contact with the plants.

3.4.2 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 indicate 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 organizations may 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 Norwegian Environment Agency, Statistics Norway and the Norwegian Institute of Bioeconomy Research 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

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

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.

3.5 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.

3.6 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 can not be handled through ordinary inventory projects, but through research projects. At the autumn cooperation meeting 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 2014),“Emissions and removals of greenhouse gases from land use, land-use change and forestry in Norway” (NIJOS, 2005), and “Emissions and methodologies for cropland and grassland used in the Norwegian national greenhouse gas inventory”(Borgen and Hylen, 2013). Statistics Norway’s documentation 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 AV- 6. 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 AV- 6 Main responsibilities for data collection

	Data	**Institution in charge of primary data collection**
Norwegian Environment Agency	• Emissions and activity data from industrial plants (point sources) (around 70 at present, but some of these do not report GHG emissions)	• Norwegian Environment 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 Norwegian Environment Agency
	• Methane recovery from landfills	• Norwegian Environment Agency
	• Amounts of waste incinerated	• Norwegian Environment Agency
	• Data on Industrial waste water	• Norwegian Environment Agency
	• Import of HFCs, PFCs and SF_6 by application. Import HFCs, PFCs and SF_6 in products.	• Norwegian Environment Agency, Statistics Norway

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, registers 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 cultivated area, animal population and manure management	• Statistics Norway, Cow Recording System at TINE BA, Norwegian Institute of Bioeconomy Research
	• 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
	• Biological treatment of waste	• Statistics Norway
The Norwegian Institute of Bioeconomy Research	• Area statistics from the national forest inventory and national land resource surveys	• Norwegian Institute of Bioeconomy Research
	• Parameters needed to estimate changes in biomass stocks from the national forest inventory.	• Norwegian Institute of Bioeconomy Research
	• 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 2015 on 1990 and 2013 emission data. Uncertainty estimates for sources are also updated yearly 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 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 1, chapter 5 (IPCC, 2006), 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 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 1, chapter 5 (IPCC, 2006)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 updated 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 balance/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 Norwegian Environment Agency). When such measured data are available, the estimated values are replaced by the measured ones:

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

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 Norwegian Environment 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 Institute of Bioeconomy Research 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. A calculation system in the form of computer programs that uses R and excel has been developed 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, , fertilizer usage on forest land, drainage of forest soil, , and area of forest wild fires) collected by Statistics Norway, Norwegian Agricultural Authority, 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 re-visitingthe 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 information from NFI, maps, and 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.

The dynamic soil model Yasso07 is used to calculate changes in carbon stock in dead organic matter and mineral 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 Institute of Bioeconomy Research. Data used for estimation of carbon stock changeson cropland, grassland, wetlands, and settlements are derived from Statistics Norway, Norwegian Meteorological Institute and Norwegian Institute of Bioeconomy Research.

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 are archived at a single location, see Table AV- 7 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 Norwegian Environment 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 Norwegian Environment 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. Confidential data previously used in the inventory are for most sources replaced by non-confidential data collected by the Norwegian Environment Agency. Confidentiality is still an issue for some of the data collected by Statistics Norway when there are few entities reporting for a source category. In order to comply with confidentiality issues, emission estimates for these sources are aggregated. This is especially prominent in source category 2F, where emissions from 2F2-5 are aggregated in category 2F6 due to confidentiality.

Table AV- 7 Responsibilities for archiving information. Capital X indicates archiving also of datasets sent from the other institutions.

	Norwegian Environment Agency	Statistics Norway	Norwegian Institute of Bioeconomy Research	Comments
Disaggregated emission factors	x	X	x	All EF (except LULUCF) 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 archived as part of the emission model
Documentation of data collection, assumption and aggregation	X	x	x	Norwegian Environment Agency is developing 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)		
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. The most relevant documentation is available in the central archive of the Norwegian Environment 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 Norwegian Environment Agency, Statistics Norway and The Institute of Bioeconomy Research are responsible for having competent personnel on duty during a review to access data if requested. Confidential information from Statistics Norway can be made available to the review team when the revision takes place in Statistics Norway's premises and after a confidentiality declaration is signed.

5.3 Allocation of responsibilities during a review

The Norwegian Environment Agency has the main responsibility for coordinating the review. Statistics Norway and The Norwegian Institute of Bioeconomy Research are allocated specific responsibilities during the review. The Norwegian Environment Agency is responsible for informing the experts at all three organizations about the timing of the review at least two months before it takes place to ensure their availability.

Table AV- 8 Main responsibilities during a review (lead in capital)

	Norwegian Environment Agency	Statistics Norway	Institute of Bioeconomy Research
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		

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7 Annexes

7.1 Annex1. 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 Institute of Bioeconomy Research	X		
• Norwegian Environment Agency	X		
Forurensning	X		
EPIM Environment Hub (EEH) previously Environmental Web (including data from the Norwegian Petroleum Directorate)	X		
• Norwegian Petroleum Industry Association (NP, norsk petroleumsinstitutt)			X
• Norwegian Petroleum Directorate (NPD) (Oljedirektoratet)		X	
• Institute of Transport Economics (TØI)			X
• Norwegian Road Federation (Opplysningsrådet for		X	

veitrafikk)		
• Norwegian Food Safety Authority (Mattilsynet)		X
• The Directorate for Civil Protection and Emergency Planning (DBS)	X	
• Directorate of Customs and Excise	X	
• SRG (Stiftelsen Returgass)		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 reorganization was to increase the consistency between the energy statistics and the emission inventories and improve the quality of both.

7.2 Annex 2. QC of activity data – existing routines

7.2.1 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 70's 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 the other units the energy use data are estimated. The estimation is based on turnover and information from the sample. There are about 18000 units in the population (2013). 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 2300 local kind of activity units (2013). 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 94 per cent of the total energy use and about 86 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 consumed. The units are classified after this criterion:
Group 1: Energy use > 50 GWh (100 units in 2013)
Group 2: 10 GWh < energy use < 50 GWh (235 units in 2013)
Group 3: Energy use > 5 GWh or/else energy cost. > 1 mil. NOK (538 units)
Group 4: Energy use < 5 GWh or/else energy cost. < 1 mil. NOK (935 units)

The local 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 activity units. At the end of the control, 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

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

7.2.2 The Norwegian Environment Agency

Emission data reported from the plants to the Norwegian Environment 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 Emission Inventory and Analysis in the Environment Agency 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.

7.2.3 The Norwegian Institute of Bioeconomy Research

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 an attempt is made 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 are 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% of the plots. 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 the 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.

7.3 Annex 3 Archiving – development of routines

7.3.1 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.

7.3.2 The Norwegian Environment Agency

Emissions from large industrial plants

Reports with emission data and QA control from large industrial plants are sent to the Norwegian Environment 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 Norwegian Environment 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 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 Norwegian Environment Agency's server, before being sent to Statistics Norway.

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

Emissions from off-shore activities

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

Data on methane recovery from landfills, amounts of waste from incineration plants and wastewater production from industry

Emission data from the landfill owners are sent to the County Departments of Environmental Affairs and are then stored in the Forurensning database. After QA/QC, these data (with supplementary notes) are stored and archived in a designated file on the Norwegian Environment 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 reported this information to the Norwegian Environment Agency annually up to 2009. The reports are archived in Ephorte. After 2009, Statistics Norway collects the amounts of imported and exported gases from registers at the Norwegian Directorate of Customs and Excise. All import of F-gases is covered in these registers, as Norway lays a tax on the import of F-gases. .

The Norwegian Environment Agency have improved its archiving routines for emissions and other data reported from industrial plants and for emissions and other data reported from oil and gas facilities in FORURENSNING.

From 2009 the Norway's official report is uploaded to UNFCCC submission portal. The CRFs tables and NIR are also uploaded to REPORTNET from 2002 and will also be uploaded there in the future. Before 2002 the reports are stored at the Norwegian Environment Agency's server.

7.3.3 The Norwegian Institute of Bioeconomy Research

The tables and data programmes etcetera are currently being stored on the institute's server. Every night a new backup copy is 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 2 REPORTS FOR CO_2 EQUIVALENT EMISSIONS 1990-2013

Although it is not a requirement, Norway has for many years included the summary 2 reports in an annex to the NIR. In 2015, this Annex is left intentionally blank.

Annex VII: SEF and Registry Changes

Annex VII consists of the files:

SEF_NO_2014_CP1.xls

SEF_NO_2014_CP2.xls

Annex A, an updated diagram of the database structure

Annex B, site acceptance test

Annex H, test report

The SEF files were reported on April 14th 2015 and are available on:
http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php

Annex VIII: QA/QC performed for GHG emissions from industrial point sources included in the national GHG inventory

1 Introduction

Norway has a long experience of using GHG emissions from industrial point sources in the national GHG inventory. The Norwegian Environment Agency has been given the authority to manage and enforce the Pollution Control Act, the Product Control Act and the Greenhouse Gas Emission Trading Act. The Norwegian Environment Agency grants permits, establishes requirements and sets emission limits, and carries out inspections to ensure compliance. This is the core responsibility of the agency, and this competence and expertise has been built up over the past 50 years.

In 2006, as part of the improvements for the Initial report, the Norwegian Environment Agency performed a major QA/QC exercise on the time series from 1990 to 2004 of greenhouse gas (GHG) emissions from the largest industrial plants in Norway. The following sectors of industry were covered: cement production, mineral fertilizers, carbide industry, production of ferroalloys, production of primary aluminium, anode manufacture, production of iron and steel, nickel production, pulp and paper manufacture, oil refineries, gas terminals, lime production, other mineral production, methanol production, plastics, other chemical industry and production of magnesium.

The main documentation from this work is contained in Excel spread sheets giving the resulting time series for each plant included in this revision, and in a documentation report (SFT 2006). The methodology was also previously presented as an Annex to the National Inventory Reports in some years following this QA/QC exercise.

The ERT of the 2012 NIR concluded (ARR12, §34) that Norway during the review provided the ERT with comprehensive information on the QA/QC procedures applied to plant-specific data, which showed that the QA/QC procedures are robust and comprehensive. The ERT however, found that the information provided in the NIR was partly outdated and recommended that Norway should include a summary of this information in its next annual submission.

Such an annex was provided with the NIR 2013 and this year's annex is an updated version. It describes the agency's approach for QA/QC of GHG emissions from industrial point sources. The annex first describes the method and data sources used for the QA/QC exercise undertaken in 2006 and then describe the changes since then.

2 Method for establishing and verifying data series of emissions 1990-2004

As part of the QA/QC exercise undertaken for the initial report, the following work procedure was established to verify data series:

- 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 the Norwegian Environment Agency 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.

The Inkosys Database (today's Forurensning)

Data from the annual company emission reports were stored in the database Inkosys.

The database contained data from 1992, and held emission and activity data from all companies reporting emissions to the agency. The Inkosys database held reported emissions and activity data

from Norwegian companies. The companies reported the data according to a manual (SFT, 2004). In the agency, the respective responsible officer 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 agency. 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 agency.

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 the Norwegian Environment Agency 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 were also covered by a voluntary agreement up to and including 2012. The most important changes since 2006 are described below.

5.1 Documentation of calculations and time series consistency

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 Norwegian Environment Agency by 1 March each year. The EU ETS reports are thoroughly checked by the 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, the agency 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 Emission Inventories and Mitigation Analysis 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 the agency 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, data from regular reporting 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.

The issue of using data from the EU ETS (see section 5.2) and implications for time-series consistency has been discussed with other Parties. We refer to paragraph 38 in Ireland's ARR 2013 as Norway is in a very similar position: "*Following a recommendation in the previous review report that Ireland report transparently on the use of EU ETS data and improve the use of plant-specific data, the Party has reported verified CO_2 emission estimates from the EU ETS for public electricity and heat production, petroleum refining and manufacture of solid fuels. These emission estimates are more accurate and reliable than the plant-specific data reported prior to the availability of the EU ETS emission estimates for the same categories. Ireland reported that the EU ETS emission estimates are available from 2005 onwards only and that the detailed information that underlies these data cannot reasonably be acquired by the national inventory agency for historical years of the relevant time series. As such, the application of the improved methodology introduces a degree of inconsistency in the time series that is unavoidable in this instance. However, given that the EU ETS emission estimates fully cover the subcategory public electricity and heat production and that these estimates match those reported separately under parallel arrangements that have been in place for many years for the same plants, it is assumed that the time-series consistency is not seriously affected and that the use of the EU ETS data does not affect the emissions trend. The ERT agrees with this assessment and commends Ireland for introducing these improvements.*

5.2 Data from the EU ETS

The GHG inventory now includes more reported data from the emissions trading system (ETS) for the periods 2005-2007, 2008-2012 and 2013. In phase III of the ETS from 2013-2020 the scope of sectors covered is expanded, including with aluminum production, ferroalloy production and intra-EU aviation. Starting in 2013 all emission data from installations in the EU ETS are subject to verification from an accredited independent third party. This means that the Norwegian Environment Agency no longer verify the emissions but provide approval of the annual emissions verified by an independent third party. 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.

Industrial installations and aircraft operators covered by the EU ETS are required to have an approved monitoring plan, according to which they monitor and report their emissions during the year. In the case of industrial installations, the monitoring plan forms part of the approved permit that is also required. Installations and aircraft operators have to monitor and report their annual emissions in accordance with two European Commission Regulations, the Monitoring and Reporting Regulation (MRR) and the Accreditation and Verification Regulation (AVR). The agency approves the monitoring plan, if we find it of high enough quality and consistent with the Monitoring and Reporting Regulation. The operators must then perform their measurements and calculations according to this plan, and report according to that. The data in the annual emissions report for a given year must be verified by an accredited verifier by 31 March of the following year. The agency then approves the verified data. 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 agency has developed a web-based electronic reporting template based the Commissions electronic templates for monitoring plans, annual emission reports. The activity-specific guidelines set out in the Monitoring and Reporting Regulation 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 Norwegian Environment 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 an operator may only change from one 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 Monitoring and Reporting Regulation into national law.

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 the Norwegian Environment Agency. 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 Statistics Norway. This is one of the reasons that Statistics Norway 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 Statistics Norway 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.

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 there is a guidance document (only in Norwegian). This has led to that the reporting requirements are stricter than before and QC performed by the inventory compilers in the agency 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 the agency 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 the agency'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).[1] 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.

[1] See http://www.norskeutslipp.no/en/Frontpage/ for the English version.

5.6 Inspections

The agency has a separate Inspection and Environmental Data Department, which includes two 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 NEA 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 trading system to check that monitoring plan is in line with the how the operator monitors and reports the emissions. The plants are to be controlled based on the risk of erroneous reporting of emissions.

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 Inspection and Environmental Data Department 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.miljodirektoratet.no/no/Tema/klima/CO2_kvoter/Klimakvoter-for-industrien/Rapportering-og-verifikasjon-av-utslipp/

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:
http://www.miljodirektoratet.no/no/Tjenester-og-verktoy/Skjema/landbasert/

Annex IX: Agriculture

1 Animal population data

Table AIX- 1 gives the animal population data used in the Norwegian emission estimations, presented at a detailed level.

Table AIX- 1 Animal population data used in the estimations. 1990-2013.

		1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Tier 1 3A	Goats	85 126	84 871	84 643	83 921	82 745	81 868	80 735	78 079	75 612
Tier 1 3A	Horses	31 430	32 988	34 345	35 943	37 373	38 013	39 382	41 211	44 175
Tier 1 3A	Swine	518 230	517 179	523 352	516 563	528 619	531 290	534 043	550 709	539 404
Tier 1 3A	Hens	2 895 663	3 694 943	3 666 601	3 616 583	3 615 625	3 556 841	3 378 714	3 117 278	3 124 095
Tier 1 3A	Chickens	4 902 412	4 892 984	5 139 295	5 099 320	5 393 030	5 777 133	6 248 106	6 539 257	6 203 475
Tier 1 3A	Duck	6 330	6 884	7 977	7 286	7 787	10 044	9 691	9 912	14 042
Tier 1 3A	Turkeys	189 260	196 512	222 632	226 918	250 967	294 944	327 053	263 682	217 056
Tier 1 3A	Deer	NE	NE	NE	NE	NE	NE	NE	794	787
Tier 1 3A	Reindeer	242 443	226 031	225 533	217 891	217 868	212 333	199 620	201 498	187 436
Tier 1 3A	Fur- bearing animals	160 537	167 549	128 866	144 123	163 429	166 346	187 756	178 333	147 277
Tier 2 3A	Dairy cows	325 896	321 722	320 442	316 054	310 034	310 346	314 199	307 099	301 923
Tier 2 3A	Beef cows	8 193	9 502	11 949	13 838	17 331	20 334	23 186	27 446	30 889
Tier 2 3A	Replacement heifer (whole lifetime)	151 025	149 240	148 908	147 085	144 680	145 140	147 216	144 394	142 372
Tier 2 3A	Finisher heifer <1 year (whole lifetime)	4 134	3 679	3 754	4 896	4 506	3 232	2 876	2 750	2 448
Tier 2 3A	Finisher bulls <1 year (whole lifetime)	13 847	12 325	12 575	16 399	15 095	10 825	9 632	9 212	7 680

Tier 2 3A	Finisher heifer >1 year (whole lifetime)	24 878	24 907	25 831	24 968	25 008	24 477	24 752	24 639	25 858
Tier 2 3A	Finisher bulls >1 year (whole lifetime)	171 871	172 077	178 459	172 496	172 769	169 104	171 004	175 160	180 116
Tier 2 3A	Sheep < 1 år (adj. for lifetime)	519540,5479	534780,8219	550021,0959	540 422	576 623	592 999	596 173	568 317	546 808
Tier 2 3A	Sheep > 1 år	1028867	1082391	1094910	1 021 346	1 119 823	1 138 821	1 107 716	1 076 217	1 100 478
Tier 1 3B	Deer	NE	NE	NE	NE	NE	NE	NE	794	787
Tier 1 3B	Reindeer	242 443	226 031	225 533	217 891	217 868	212 333	199 620	201 498	187 436
Tier 1 3B	Horses	31 430	32 988	34 345	35 943	37 373	38 013	39 382	41 211	44 175
Tier 1 3B	Mink, male	2 969	2 913	2 204	2 512	2 572	2 326	2 705	2 947	2 836
Tier 1 3B	Mink, female	53 442	52 442	39 668	45 220	46 292	41 873	48 698	53 049	51 045
Tier 1 3B	Foxes, male	6 987	7 529	5 838	6 468	7 688	8 196	9 150	8 209	6 267
Tier 1 3B	Foxes, female	97 139	104 665	81 157	89 923	106 878	113 950	127 203	114 128	87 129
Tier 1 3B	Sheep < 1 år (adj. for lifetime)	519 541	534 781	550 021	540 422	576 623	592 999	596 173	568 317	546 808
Tier 1 3B	Sheep > 1 år	1 028 867	1 082 391	1 094 910	1 021 346	1 119 823	1 138 821	1 107 716	1 076 217	1 100 478
Tier 1 3B	Dairy goats	64 041	63 987	62 170	61 624	59 546	58 630	57 948	55 436	53 431
Tier 1 3B	Other goats	21 085	20 884	22 473	22 297	23 199	23 238	22 787	22 643	22 181
Tier 2 3B	Dairy cows	325 896	321 722	320 442	316 054	310 034	310 346	314 199	307 099	301 923
Tier 2 3B	Non-Dairy Cattle	373 948	371 729	381 476	379 682	379 389	373 111	378 666	383 601	389 363
Tier 2 3B	Beef cows	8 193	9 502	11 949	13 838	17 331	20 334	23 186	27 446	30 889
Tier 2 3B	Young cattle	365 755	362 227	369 527	365 844	362 058	352 777	355 480	356 155	358 474
Tier 2 3B	Replacement heifer (whole lifetime)	151 025	149 240	148 908	147 085	144 680	145 140	147 216	144 394	142 372
Tier 2 3B	Finisher heifer <1 year (whole lifetime)	4 134	3 679	3 754	4 896	4 506	3 232	2 876	2 750	2 448
Tier 2 3B	Finisher bulls <1 year (whole lifetime)	13 847	12 325	12 575	16 399	15 095	10 825	9 632	9 212	7 680
Tier 2 3B	Finisher heifer >1 year (whole lifetime)	24 878	24 907	25 831	24 968	25 008	24 477	24 752	24 639	25 858

Tier 2 3B	Finisher bulls >1 year (whole lifetime)	171 871	172 077	178 459	172 496	172 769	169 104	171 004	175 160	180 116
Tier 2 3B	Poultry	7 993 665	8 791 323	9 036 505	8 950 107	9 267 410	9 638 963	9 963 563	9 930 129	9 558 668
Tier 2 3B	Hens	2 895 663	3 694 943	3 666 601	3 616 583	3 615 625	3 556 841	3 378 714	3 117 278	3 124 095
Tier 2 3B	Chicks bred for laying hens, animal places	1 729 532	1 715 650	1 647 717	1 535 303	1 517 701	1 424 417	1 390 059	1 413 912	1 464 508
Tier 2 3B	Chicks for slaughtering, animal places	3 172 880	3 177 333	3 491 578	3 564 017	3 875 329	4 352 716	4 858 047	5 125 345	4 738 967
Tier 2 3B	Ducks for breeding	2 326	2 865	3 550	2 757	2 852	4 490	3 478	2 875	1 895
Tier 2 3B	Ducks for slaughtering, animal places	4 004	4 019	4 427	4 529	4 935	5 555	6 213	7 037	12 147
Tier 2 3B	Turkey/goose for breeding	13 180	16 235	20 115	15 625	16 161	25 441	19 710	16 293	10 736
Tier 2 3B	Turkey for slaughtering, animal places	176 080	180 277	202 517	211 294	234 806	269 504	307 343	247 389	206 320
Tier 2 3B	Swine	518 230	517 179	523 352	516 563	528 619	531 290	534 043	550 709	539 404
Tier 2 3B	Young pigs for breeding	23 047	24 030	23 194	22 961	23 179	24 714	24 495	24 251	24 818
Tier 2 3B	Sows	62 683	64 822	65 203	62 194	61 823	63 944	65 292	64 583	63 153
Tier 2 3B	Pigs for slaughter, animal places	432 500	428 327	434 955	431 408	443 617	442 632	444 256	461 875	451 433

		1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Tier 1 3A	Goats	73 998	72 504	69 719	66 591	67 084	65 957	68 898	66 226	66 885
Tier 1 3A	Horses	46 501	51 156	53 000	53 231	55 319	57 698	61 784	63 399	69 311
Tier 1 3A	Swine	562 011	533 127	520 132	514 101	520 283	559 231	556 909	565 216	540 482
Tier 1 3A	Hens	3 144 497	3 228 812	3 064 785	3 082 000	3 214 509	3 419 760	3 343 410	3 302 308	3 546 749
Tier 1 3A	Chickens	6 433 180	7 254 844	6 988 871	7 600 737	7 716 787	8 399 256	8 524 719	9 031 798	9 816 004
Tier 1 3A	Duck	6 699	21 079	18 639	22 163	16 176	19 152	21 423	27 582	37 362
Tier 1 3A	Turkeys	245 213	261 023	268 629	297 045	342 596	413 639	399 208	382 192	436 114
Tier 1 3A	Deer	1 739	2 280	1 859	2 719	2 423	2 718	4 173	5 183	4 830

Tier 1 3A	Reindeer	187 967	172 407	168 288	191 838	210 075	232 838	234 608	233 160	243 251
Tier 1 3A	Fur- bearing animals	128 859	154 685	156 964	154 137	150 518	163 266	175 002	192 735	189 899
Tier 2 3A	Dairy cows	304 769	284 880	278 482	272 296	270 270	263 422	255 663	250 903	246 624
Tier 2 3A	Beef cows	34 846	42 324	45 317	45 831	48 727	50 605	54 841	55 706	57 609
Tier 2 3A	Replacement heifer (whole lifetime)	144 100	135 725	133 092	130 297	129 668	122 011	123 006	118 408	112 974
Tier 2 3A	Finisher heifer <1 year (whole lifetime)	6 278	6 267	4 895	4 983	4 360	3 866	3 745	4 006	3 944
Tier 2 3A	Finisher bulls <1 year (whole lifetime)	18 553	23 295	17 755	18 296	16 371	15 537	14 868	15 019	14 704
Tier 2 3A	Finisher heifer >1 year (whole lifetime)	29 162	32 443	33 275	32 393	30 392	29 507	29 098	29 342	28 933
Tier 2 3A	Finisher bulls >1 year (whole lifetime)	194 957	175 101	157 622	160 048	160 044	158 457	160 711	158 177	156 132
Tier 2 3A	Sheep < 1 år (adj. for lifetime)	622 551	639 746	654 334	641 394	668 572	477 713	467 648	466 899	448 634
Tier 2 3A	Sheep > 1 år	1 102 068	1 129 458	1 138 073	1 104 909	1 111 513	1 083 216	1 057 911	1 002 006	1 019 998
Tier 1 3B	Deer	1 739	2 280	1 859	2 719	2 423	2 718	4 173	5 183	4 830
Tier 1 3B	Reindeer	187 967	172 407	168 288	191 838	210 075	232 838	234 608	233 160	243 251
Tier 1 3B	Horses	46 501	51 156	53 000	53 231	55 319	57 698	61 784	63 399	69 311
Tier 1 3B	Mink, male	2 986	3 607	3 685	3 794	3 606	4 344	5 171	6 189	6 361
Tier 1 3B	Mink, female	53 756	64 919	66 325	68 299	64 916	78 194	93 076	111 393	114 498
Tier 1 3B	Foxes, male	4 839	5 782	5 835	5 505	5 502	5 417	5 151	5 043	4 633
Tier 1 3B	Foxes, female	67 277	80 378	81 119	76 538	76 493	75 311	71 605	70 110	64 407
Tier 1 3B	Sheep < 1 år (adj. for lifetime)	622 551	639 746	654 334	641 394	668 572	477 713	467 648	466 899	448 634
Tier 1 3B	Sheep > 1 år	1 102 068	1 129 458	1 138 073	1 104 909	1 111 513	1 083 216	1 057 911	1 002 006	1 019 998
Tier 1 3B	Dairy goats	51 847	50 578	47 364	45 381	45 196	44 103	44 374	41 069	39 721
Tier 1 3B	Other goats	22 151	21 926	22 355	21 210	21 888	21 854	24 524	25 157	27 164
Tier 2 3B	Dairy cows	304 769	284 880	278 482	272 296	270 270	263 422	255 663	250 903	246 624

Tier 2 3B	Non-Dairy Cattle	427 896	415 155	391 956	391 848	389 562	379 983	386 269	380 658	374 296
Tier 2 3B	Beef cows	34 846	42 324	45 317	45 831	48 727	50 605	54 841	55 706	57 609
Tier 2 3B	Young cattle	393 050	372 831	346 639	346 017	340 835	329 378	331 428	324 952	316 687
Tier 2 3B	Replacement heifer (whole lifetime)	144 100	135 725	133 092	130 297	129 668	122 011	123 006	118 408	112 974
Tier 2 3B	Finisher heifer <1 year (whole lifetime)	6 278	6 267	4 895	4 983	4 360	3 866	3 745	4 006	3 944
Tier 2 3B	Finisher bulls <1 year (whole lifetime)	18 553	23 295	17 755	18 296	16 371	15 537	14 868	15 019	14 704
Tier 2 3B	Finisher heifer >1 year (whole lifetime)	29 162	32 443	33 275	32 393	30 392	29 507	29 098	29 342	28 933
Tier 2 3B	Finisher bulls >1 year (whole lifetime)	194 957	175 101	157 622	160 048	160 044	158 457	160 711	158 177	156 132
Tier 2 3B	Poultry	9 829 589	10 765 758	10 340 924	11 001 944	11 290 068	12 251 807	12 288 761	12 743 879	13 836 228
Tier 2 3B	Hens	3 144 497	3 228 812	3 064 785	3 082 000	3 214 509	3 419 760	3 343 410	3 302 308	3 546 749
Tier 2 3B	Chicks bred for laying hens, animal places	1 016 137	997 262	858 302	1 104 207	999 584	1 358 108	1 341 532	1 152 624	1 195 030
Tier 2 3B	Chicks for slaughtering, animal places	5 417 043	6 257 582	6 130 569	6 496 529	6 717 203	7 041 148	7 183 188	7 879 173	8 620 974
Tier 2 3B	Ducks for breeding	3 163	3 044	4 143	6 706	5 386	5 468	6 807	6 735	10 808
Tier 2 3B	Ducks for slaughtering, animal places	3 535	18 035	14 496	15 458	10 791	13 683	14 617	20 846	26 553
Tier 2 3B	Turkey/goose for breeding	17 925	17 248	23 477	37 999	30 518	30 988	38 571	38 167	61 248
Tier 2 3B	Turkey for slaughtering, animal places	227 289	243 775	245 152	259 045	312 077	382 652	360 637	344 025	374 866
Tier 2 3B	Swine	562 011	533 127	520 132	514 101	520 283	559 231	556 909	565 216	540 482
Tier 2 3B	Young pigs for breeding	33 275	31 172	31 501	32 426	35 450	35 733	38 930	37 483	38 494
Tier 2 3B	Sows	61 118	57 351	55 955	54 570	58 619	60 829	60 584	59 647	57 969
Tier 2 3B	Pigs for slaughter, animal places	467 618	444 604	432 676	427 105	426 214	462 669	457 395	468 086	444 019

		2008	**2009**	**2010**	**2011**	**2012**	**2013**
Tier 1 3A	Goats	65 538	64 389	62 807	62 768	60 776	58 771

Tier 1 3A	Horses	72 478	75 103	76 752	77 101	77 086	77 059
Tier 1 3A	Swine	547 379	570 200	577 011	574 182	561 091	562 889
Tier 1 3A	Hens	3 737 506	3 964 962	3 945 607	3 877 138	4 050 447	4 216 858
Tier 1 3A	Chickens	10 813 439	10 557 002	10 693 568	10 473 343	10 782 855	12 285 794
Tier 1 3A	Duck	38 386	29 594	36 459	39 902	19 876	49 026
Tier 1 3A	Turkeys	524 371	569 396	483 804	487 726	516 416	480 926
Tier 1 3A	Deer	5 867	6 835	7 249	7 808	8 367	7 829
Tier 1 3A	Reindeer	253 721	248 522	254 384	251 071	253 092	258 360
Tier 1 3A	Fur- bearing animals	174 904	155 204	157 194	168 895	192 447	192 447
Tier 2 3A	Dairy cows	238 550	210 554	209 094	201 165	203 592	196 085
Tier 2 3A	Beef cows	60 401	63 803	67 110	68 539	70 434	71 834
Tier 2 3A	Replacement heifer (whole lifetime)	110 954	109 286	109 150	108 516	106 679	107 650
Tier 2 3A	Finisher heifer <1 year (whole lifetime)	3 876	3 128	2 966	3 587	3 419	3 660
Tier 2 3A	Finisher bulls <1 year (whole lifetime)	13 775	11 762	11 685	13 128	15 042	16 552
Tier 2 3A	Finisher heifer >1 year (whole lifetime)	27 940	27 062	27 000	24 694	21 480	23 600
Tier 2 3A	Finisher bulls >1 year (whole lifetime)	151 132	152 100	148 883	145 825	141 045	143 867
Tier 2 3A	Sheep < 1 år (adj. for lifetime)	447 373	464 270	461 592	480 506	463 456	458 413
Tier 2 3A	Sheep > 1 år	1 035 624	1 061 636	1 054 092	1 050 191	1 048 699	1 042 449
Tier 1 3B	Deer	5 867	6 835	7 249	7 808	8 367	7 829
Tier 1 3B	Reindeer	253 721	248 522	254 384	251 071	253 092	258 360
Tier 1 3B	Horses	72 478	75 103	76 752	77 101	77 086	77 059
Tier 1 3B	Mink, male	6 082	5 526	5 683	6 302	7 440	9 597
Tier 1 3B	Mink, female	109 468	99 462	102 297	113 439	133 928	172 737

Tier 1 3B	Foxes, male	3 983	3 370	3 302	3 298	3 428	3 484
Tier 1 3B	Foxes, female	55 372	46 847	45 911	45 855	47 651	48 432
Tier 1 3B	Sheep < 1 år (adj. for lifetime)	447 373	464 270	461 592	480 506	463 456	458 413
Tier 1 3B	Sheep > 1 år	1 035 624	1 061 636	1 054 092	1 050 191	1 048 699	1 042 449
Tier 1 3B	Dairy goats	38 146	37 427	35 706	34 783	33 982	31 406
Tier 1 3B	Other goats	27 392	26 962	27 101	27 985	26 794	27 365
Tier 2 3B	Dairy cows	238 550	210 554	209 094	201 165	203 592	196 085
Tier 2 3B	Non-Dairy Cattle	368 078	367 141	366 794	364 289	358 099	367 163
Tier 2 3B	Beef cows	60 401	63 803	67 110	68 539	70 434	71 834
Tier 2 3B	Young cattle	307 677	303 338	299 684	295 750	287 665	295 329
Tier 2 3B	Replacement heifer (whole lifetime)	110 954	109 286	109 150	108 516	106 679	107 650
Tier 2 3B	Finisher heifer <1 year (whole lifetime)	3 876	3 128	2 966	3 587	3 419	3 660
Tier 2 3B	Finisher bulls <1 year (whole lifetime)	13 775	11 762	11 685	13 128	15 042	16 552
Tier 2 3B	Finisher heifer >1 year (whole lifetime)	27 940	27 062	27 000	24 694	21 480	23 600
Tier 2 3B	Finisher bulls >1 year (whole lifetime)	151 132	152 100	148 883	145 825	141 045	143 867
Tier 2 3B	Poultry	15 113 702	15 120 955	15 159 438	14 878 108	15 369 594	17 032 604
Tier 2 3B	Hens	3 737 506	3 964 962	3 945 607	3 877 138	4 050 447	4 216 858
Tier 2 3B	Chicks bred for laying hens, animal places	1 099 306	1 442 743	1 166 453	1 010 963	966 488	1 224 355
Tier 2 3B	Chicks for slaughtering, animal places	9 714 132	9 114 259	9 527 116	9 462 380	9 816 367	11 061 440
Tier 2 3B	Ducks for breeding	9 673	3 278	5 535	2 233	2 034	1 989
Tier 2 3B	Ducks for slaughtering, animal places	28 713	26 317	30 924	37 668	17 842	47 037
Tier 2 3B	Turkey/goose for breeding	54 813	18 573	31 366	12 656	11 523	11 268
Tier 2 3B	Turkey for slaughtering, animal places	469 558	550 823	452 438	475 070	504 892	469 657

Tier 2 3B	Swine	547 379	570 200	577 011	574 182	561 091	562 889
Tier 2 3B	Young pigs for breeding	41 205	42 973	40 770	42 023	42 636	42 960
Tier 2 3B	Sows	57 188	57 469	56 234	53 277	53 154	53 004
Tier 2 3B	Pigs for slaughter, animal places	448 986	469 758	480 007	478 882	465 301	466 925

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

2.1 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 AIX- 2.

Table AIX- 2 GE and Ym used for the respective animals at the subcategory level. 1990-2013

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Mature dairy cows	Average GE (MJ/head/day)	294.65	292.11	293.07	295.62	294.86	293.92	292.74	291.36	291.55	290.75	290.29	290.53
	Ym (%)	7.32	7.37	7.34	7.34	7.37	7.38	7.39	7.41	7.41	7.42	7.43	7.43
Mature non-dairy cattle	Average GE (MJ/head/day)	197.28	197.28	197.28	197.28	197.28	197.28	197.28	197.28	197.28	197.28	197.28	197.28
	Ym (%)	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09
Young cattle	Average GE (MJ/head/day)	33.04	32.90	33.34	34.18	35.31	34.98	35.04	35.50	36.07	37.88	37.51	36.25
	Ym (%)	11.33	11.33	11.30	11.27	11.20	11.19	11.18	11.15	11.11	11.05	11.09	11.16
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	46.03
	Ym (%)	5.24	5.26	5.25	5.21	5.24	5.24	5.21	5.22	5.26	5.24	5.25	5.24

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mature dairy cows	Average GE (MJ/head/day)	292.68	295.81	299.52	302.39	303.07	307.89	311.78	314.60	316.92	315.93	320.40	325.34
	Ym (%)	7.41	7.35	7.29	7.24	7.22	7.14	7.08	7.03	6.99	6.98	6.90	6.83
Mature non-dairy cattle	Average GE (MJ/head/day)	197.28	197.28	197.28	197.28	197.28	197.28	197.28	197.28	197.28	197.28	197.28	197.28
	Ym (%)	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09
Young cattle	Average GE (MJ/head/day)	36.69	36.94	37.62	38.80	38.90	39.95	40.22	40.75	40.65	40.59	40.45	41.10
	Ym (%)	11.13	11.11	11.06	10.98	10.98	10.92	10.90	10.85	10.86	10.87	10.89	10.86
Sheep	Average GE (MJ/head/day)	46.09	46.05	45.83	45.85	45.95	45.76	45.71	45.67	45.75	45.78	45.67	45.73
	Ym (%)	5.22	5.23	5.25	5.24	5.22	5.27	5.28	5.29	5.27	5.27	5.29	5.27

2.2 Method description

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

2.2.1 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.

2.2.2 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 AIX- 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 AIX- 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[2].

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 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

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[2] 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 description

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 AIX- 1 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.

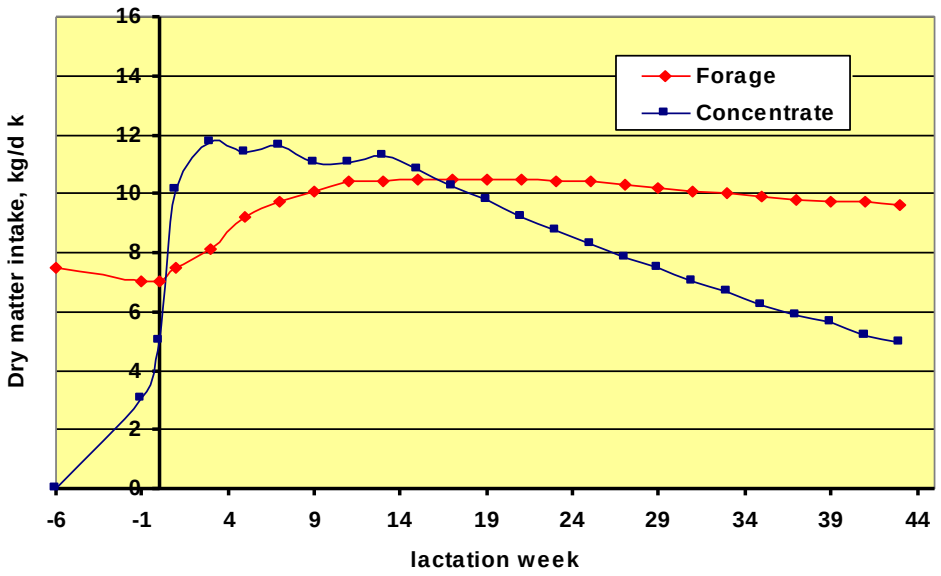

Figure AIX- 1 Example of estimated daily feed intake through the lactation cycle. Medium forage quality and a 305 d lactation yield of 7000 kg

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:

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

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:

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

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:

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

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 AIX- 4 present examples of GE and Y_m at different production levels and different proportions of concentrate in the diet.

Table AIX- 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 AIX- 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%.

2.2.3 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 AIX- 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.

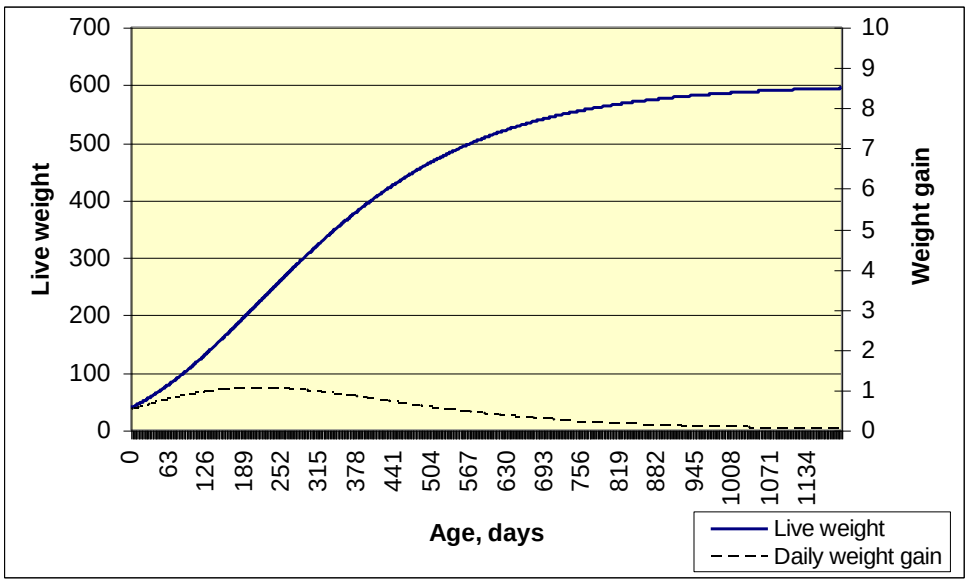

Figure AIX- 2 Gompertz growth function for prediction of live weight change and daily weight gain

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:

$$\text{Intake} = = \frac{IC}{(P)FVF + (1-P)FVC} \qquad \frac{ARNEL}{(P)NELF + (1-P)NELC}$$

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 AIX- 1) 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 AIX- 5 present examples of daily GE intake and Y_m at different age at slaughter and carcass weights.

Table AIX- 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 AIX- 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 AIX- 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 AIX- 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.

2.2.4 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 (2006) 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 AIX- 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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3 Nitrogen excretion tables, AD tables for calculation of N and VS for cattle and $Frac_{GASF}$

3.1 Nitrogen excretion tables

Table AIX- 7 Nitrogen excretion table. Total N. N excretion per animal, kg

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Tot-N, dairy cow[1]	107.6	106.5	106.7	100.4	96.4	96.2	95.8	95.2	97.4	99.0	100.9	103.3	106.3	109.9	111.7	113.2	115.6	117.8	121.6	123.0	124.0	123.2	125.0	127.1
Tot-N, beef cow[1]	60.7	60.6	60.5	61.0	61.3	61.4	61.5	61.5	61.6	61.4	61.4	61.7	61.8	62.2	62.6	63.0	63.2	63.8	64.1	64.4	64.6	64.4	64.5	64.8
Tot-N, Replacement heifer [2]	66.8	66.0	65.6	65.2	65.2	65.9	66.2	66.1	67.4	67.2	67.8	69.6	70.7	73.3	74.8	77.0	78.4	80.8	82.8	83.9	84.9	84.1	84.6	86.6
Tot-N, Finisher heifer[3]	58.5	58.6	58.9	59.6	61.0	61.2	61.5	60.0	62.9	54.9	55.8	61.2	61.1	63.2	64.5	64.3	64.1	62.3	62.5	65.3	66.1	63.5	64.2	64.4
Tot-N, Finisher bull[3]	53.8	53.6	54.3	52.0	53.8	54.7	55.5	56.4	59.3	56.8	52.6	58.5	60.7	64.0	65.0	65.9	67.0	66.0	67.4	68.7	68.7	66.7	65.5	66.5
Sows	18.4	19.1	19.9	20.6	21.4	22.2	22.9	23.7	24.4	25.2	25.9	26.7	27.5	28.2	29.0	29.7	30.5	31.3	32.0	32.8	33.5	34.3	34.3	34.3
Pigs for slaughter	4.0	4.0	3.9	3.9	3.8	3.8	3.8	3.7	3.7	3.7	3.6	3.6	3.5	3.5	3.5	3.4	3.4	3.4	3.3	3.3	3.2	3.2	3.2	3.2
Young pigs for breeding	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.7	9.7
Hens[4]	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Chicks bred for laying hens[4]	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chicks for slaughtering[4]	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Turkey[4]	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5
Duck[4]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Goose[4]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Horse	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Dairy goats	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9
Other mature goats	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Young goat	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Goat, all	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
Sheep > 1 år	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Sheep < 1 år	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Mink	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Fox	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Deer	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Reindeer	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Turkey/goose/duck for breeding[4]	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	2.0
Chicks for slaughtering[5]	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Turkey[5]	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Chicks bred for laying hens [5]	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Duck [5]	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Pigs for slaughter[5]	10.0	10.0	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3	10.4	10.4	10.4	10.5	10.5	10.5	10.5	10.6	10.6	10.6

[1]Applies per cow-year, [2]applies until first calving, [3]applies for whole life-cycle, [5]N-excretion per counted animal, [4]N excretion per pen, kg per year

Table AIX- 8 Nitrogen excretion table. Ammonioum N

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Urine-N, dairy cow[1]	60.4	59.9	59.9	52.8	48.8	48.8	48.6	48.4	50.6	52.3	54.3	56.6	59.1	62.0	62.8	63.7	65.9	67.1	70.0	70.7	71.2	70.8	71.6	72.6
Urine-N beef cow[1]	33.0	32.9	32.8	33.3	33.5	33.6	33.7	33.7	33.8	33.6	33.6	33.8	33.9	34.2	34.5	34.9	35.0	35.4	35.7	35.9	36.1	35.9	36.0	36.3
Urine-N, Replacement heifer [2]	34.0	33.5	33.2	32.0	31.5	32.0	32.2	32.1	33.2	33.4	33.9	35.4	36.4	38.3	39.3	40.8	41.9	43.6	45.1	45.9	46.5	46.0	46.3	47.6
Urine-N, Finisher heifer[3]	35.3	35.3	35.5	36.0	36.8	37.0	37.1	36.2	38.1	32.9	33.5	37.0	36.9	38.2	39.1	39.0	38.8	37.7	37.8	39.6	40.1	38.5	38.9	39.0
Urine-N, Finisher bull[3]	31.6	31.5	31.9	29.1	29.5	30.1	30.6	31.2	33.4	32.0	29.6	33.8	35.6	38.1	38.7	39.3	40.3	39.6	40.9	41.7	41.7	40.4	39.6	40.2
Sows	12.6	13.1	13.6	14.1	14.6	15.1	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.4	19.9	20.4	20.9	21.4	21.9	22.4	22.9	22.9	22.9
Pigs for slaughter	2.8	2.8	2.7	2.7	2.7	2.6	2.6	2.6	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.2	2.2	2.2	2.1	2.1	2.1
Young pigs for breeding	5.3	5.4	5.4	5.5	5.5	5.6	5.6	5.7	5.7	5.8	5.8	5.9	6.0	6.0	6.1	6.1	6.2	6.2	6.3	6.3	6.4	6.5	7.5	7.5
Hens[4]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Chicks bred for laying hens[4]	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chicks for slaughtering[4]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey[4]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Duck[4]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Goose[4]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Horse	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Dairy goats	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Other mature goats	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Young goat	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Goat, all	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3

Sheep > 1 år	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Sheep < 1 år	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Mink	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Fox	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Deer	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Reindeer	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Turkey/goose/duck for breeding[4]	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.2	0.8
Chicks for slaughtering[5]	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Turkey[5]	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
Chicks bred for laying hens [5]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Duck [5]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Pigs for slaughter[5]	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

[1]Applies per cow-year, [2]applies until first calving, [3]applies for whole life-cycle, [5]N-excretion per counted animal, [4]N excretion per pen, kg per year

3.2 Activity data tables for calculation of N and VS for cattle

Table AIX- 9 Activity data used for calculation of N and VS for cattle

Year	**Dairy cows**				**Beef cow (mature non-dairy cattle)**			
	Milk yeld (kg ECM per cow per year)	Weight (kg)	Protein content in the roughhage g/kg dry matter	calculated protein content, g/kg dry matter	Milk yeld (kg ECM per cow per year)	Weight (kg)	Protein content in the roughhage g/kg dry matter	calculated protein content, g/kg dry matter
1990	6 320	508	150	184	2 000	508	120	200
1991	6 206	504	150	184	2 000	504	120	200
1992	6 233	502	150	184	2 000	502	120	200
1993	6 400	514	150	161	2 000	514	120	200
1994	6 376	521	150	149	2 000	521	120	200
1995	6 326	525	150	149	2 000	525	120	200
1996	6 265	526	150	149	2 000	526	120	200
1997	6 199	526	150	149	2 000	526	120	200
1998	6 207	529	150	155	2 000	529	120	200
1999	6 170	525	150	161	2 000	525	120	200
2000	6 156	524	150	167	2 000	524	120	200
2001	6 164	530	150	172	2 000	530	120	200
2002	6 278	532	150	178	2 000	532	120	200
2003	6 420	542	150	184	2 000	542	120	200
2004	6 594	550	150	184	2 000	550	120	200
2005	6 723	562	150	184	2 000	562	120	200

2006	6 742	566	150	190	2 000	566	120	200
2007	6 961	578	150	190	2 000	578	120	200
2008	7 144	585	150	195	2 000	585	120	200
2009	7 276	592	150	195	2 000	592	120	200
2010	7 373	597	150	195	2 000	597	120	200
2011	7 309	592	150	195	2 000	592	120	200
2012	7 509	594	150	195	2 000	594	120	200
2013	7 919	602	150	195	2 000	602	120	200
Year	**Heifer for replacement**				**Bulls for slaughter**			
	Weight by first calving (kg)	Feeding period, months	Protein content in the roughhage g/kg dry matter	Protein content in concentrates, g/kg dry matter	Slaughter weight	Slaughter age. Months	Protein content in the roughhage g/kg dry matter	Protein content in concentrates, g/kg dry matter
1990	435	26.0	140	184	255	18.8	140	184
1991	431	26.0	140	184	254	18.9	140	184
1992	430	26.0	140	184	257	18.9	140	184
1993	440	26.0	140	161	262	18.9	140	161
1994	446	26.0	140	149	273	18.9	140	149
1995	449	26.0	140	149	276	18.9	140	149
1996	451	26.0	140	149	279	18.9	140	149
1997	450	26.0	140	149	281	19.0	140	149
1998	453	26.0	140	155	287	19.1	140	155
1999	449	26.0	140	161	281	17.7	140	161
2000	448	26.0	140	167	269	16.7	140	167

2001	454	26.0	140	172	279	18.0	140	172
2002	456	26.0	140	178	283	18.1	140	178
2003	464	26.0	140	184	289	18.3	140	184
2004	471	26.0	140	184	292	18.4	140	184
2005	481	26.0	140	184	296	18.0	140	184
2006	485	25.9	140	190	297	18.0	140	190
2007	495	25.9	140	190	296	17.5	140	190
2008	501	26.0	140	195	298	17.4	140	195
2009	507	26.0	140	195	301	17.4	140	195
2010	511	25.9	140	195	302	17.4	140	195
2011	507	26.0	140	195	297	17.1	140	195
2012	509	26.1	140	195	294	16.9	140	195
2013	515	26.2	140	195	298	16.7	140	195

3.3 $Frac_{GASF}$

Table AIX- 10 and Table AIX- 11 presents weighting of loss factors based on basis data for N-loss factor, N-share and amount for the different synthetic fertilisers. For the period 1990-1999 the same estimate for nitrogen loss and amount of nitrogen distributed on fertiliser type are used, which gives a constant $Frac_{gasf}$ (total N-losses are however adjusted for total nitrogen sale each year). The NH_3 emission factors (per cent loss of N) for the different types of fertilisers was given by ECETOC (1994) and Norsk Hydro, *pers. Comm.*[3]. Table AIX- 12 presents the timeseries for $Frac_{gasf}$ used in the Norwegian inventory.

Table AIX- 10 Weighting of loss factors based on basis data for N-loss factor, N-share and amount for the different synthetic fertilisers. 2013

Fertiliser type	**Amount of fertiliser (tonnes)**	**%-N**	**Loss (% of N)**
Ammonium nitrate	9274	34	5
Ammonium nitrate m/S	28994	27	5
Potassium sulphate	62	0	0
Potassium sulphate m/Mg	548	0	0
Potassium chloride	128	0	0
Kalkamonsalpeter	22306	27	1
Calcium nitrate	14972	16	0
Calcium nitrate m/B	3248	15	0
NK-fertiliser 22-12	3452	15	1
NP-fertiliser 10-4	420	10	1
NP fertiliser 12-23	770	12	1
NPK-fertiliser 6-5-20	46	6	1
NPK-fertiliser 8-5-19	888	8	1
NPK-fertiliser 12-4-18	21037	12	1
NPK-fertiliser 18-3-15	31836	18	1
NPK-fertiliser 19-4-12	5017	19	1
NPK-fertiliser 21-3-8	1900	21	1

[3] Norsk Hydro (1995): Personal information, Kaarstad, Norsk Hydro.

NPK-fertiliser 22-2-12	36742	22	1
NPK-fertiliser 22-3-10	120241	22	1
NPK-fertiliser 25-2-6	96820	25	1
NPK-fertiliser 27-3-5	30828	27	1
PK-fertiliser 0-11-21	261	0	1
P-fertiliser 0-20-0	105	0	1
Urea	219	46	15
Other fertiliser with N content	1417	20	1
Other fertiliser	182	0	1

Source: Statistics Norway

Table AIX- 11 Weighting of loss factors based on basis data for N-loss factor, N-share and amount for the different synthetic fertilisers. 1990-1999

Fertiliser type	**Amount of fertiliser (tonnes)**	**%-N**	**Loss (% of N)**
Calcium nitrate	65869	15.5	0
Calcium ammonium nitrate	40642	27.5	1
Forest-calcium ammon	1483	15.0	1
Forest-AN	7	27.0	0
Urea	754	46.0	15
Ammonium sulphate	11	27.0	5
Ammonium nitrate	76	27.0	5
NK 17-17	257	16.9	1
NK 17-20	359	16.9	1
NK19-15	385	19.0	1
NK 22-10	2575	22.0	1
NK21-10	630	20.3	1
NK 22-10	2575	22.0	1
NPK 6-7-21	671	6.0	1
NPK 11-5-17	24826	11.0	1
NPK 11-5-17	111	11.0	1
NPK 14-4-15	82	14.0	1

NPK 14-6-16	1745	14.0	1
NPK15-4-12	5767	14.6	1
NPK15-4-12 m/Co	13	15.0	1
NPK 17-5-13	36892	17.2	1
NPK 18-3-15	102101	17.6	1
NPK 18-3-15	1347	17.8	1
NPK 20-2-12	863	21.0	1
NPK 20-3-6	83	20.0	1
NPK 21-4-10	158262	20.6	1
NPK 21-4-10	332	21.2	1
NPK 22-2-12	61932	21.6	1
NPK 23-3-6	221	23.0	1
NPK 23-3-6	28488	23.0	1
N- 24 m/micro	0	24.0	1
NPK 10-3-7	191	10.0	1
NPK 11-1-7	1	11.0	1
NPK 14-0-6	113	14.0	1
NPK 19-2-4	736	19.0	1
NPK 15-3-7	50	15.0	1
NPK 7-2-10	106	7.0	1
18-0-0 foliar spray	9	18.0	1
NPK 10-0-9	11	10.0	1
NPK 3-2-9	1	3.0	1

NPK (Nitrogen,phosphorus, potassium)
Source: Statistics Norway

Table AIX- 12 $Frac_{gasf}$ used in the Norwegian inventory. 1990-2013.

Year	$Frac_{gasf}$
1990	0.009
1991	0.009
1992	0.009
1993	0.009
1994	0.009
1995	0.009
1996	0.009

1997	0.009
1998	0.009
1999	0.009
2000	0.010
2001	0.010
2002	0.011
2003	0.011
2004	0.012
2005	0.011
2006	0.011
2007	0.012
2008	0.010
2009	0.017
2010	0.013
2011	0.013
2012	0.014
2013	0.014

Source: Statistics Norway

Annex X: Overview of notation keys IE and NE

Norway has had technical difficulties in 2015 with the specification of methods, emission factors, notation keys and documentation boxes in the CRF. We have strived for completeness and consistency with the information in the NIR, and much information about the use of notation keys IE and NE are included in the documentation boxes in the CRF. At the time of reporting there are still improvements that can be made.

It is our intention to improve this in the inventory submission in 2016, but for the 2015 submission, the information about use of notation keys IE and NE is gathered in this annex.

1.1 Included elsewhere (IE)

1.1.1 Energy (source category 1)

Table AX. 1. Description of the use of notation IE in the energy sector

Notation key	Source category	Components	Allocation as per IPCC Guidelines	Allocation used by Norway	Explanation
IE	1A3ei Pipeline transport - gaseous fuels	CO_2, CH_4, N_2O	1A3ei	1A1cii	It is not possible to split emissions from emissions in 1A1c ii
IE	1B1aii Underground mines - Post-mining activities	CO_2, CH_4	1B1aii	1B1ai	It is not possible to split emissions into mining and post mining activities
IE	1B2aii Surface mines - Post-mining activities	CO_2, CH_4	1B2aii	1B2ai	It is not possible to split emissions into mining and post mining activities
IE	1B2a2 Oil - Production 1Bb1 Natural gas - Exploration	CO_2, CH_4	1B2a2 1B2a1	1.A.1.c and 1.B.2.C.	It is combustion for energy purposes in oil and gas exploration and venting and flaring.
IE	1B2b2 Natural gas – Production 1B2b3 Natural gas - Processing	CO_2, CH_4	1B2b2 1B2b3	1.A.1.c, 1.B.2.B.5 and 1.B.2.C.2	It is combustion for energy purposes in oil and gas production off shore, gas terminals on land, venting at gas terminals, and flaring.
IE	1B2b4 Natural gas - Transmission and storage	CO_2	1B2b4	1.B.2.B.6	Emissions are included with emissions from gas terminals and cannot be split
IE	1B2b5 Natural gas - Distribution	CO_2, CH_4	1B2b5	1.B.2.B.6	emissions are included with emissions from gas terminals and cannot be split
IE	1B2c1i Venting and Flaring - Venting - Oil 1B2c1ii Venting and Flaring - Venting - Gas	CO_2, CH_4	1B2c1i 1B2c1ii	1.B.2.C.1iii	It is not possible to split emissions from emissions in 1B2c1 iii
IE	1B2c2iii Venting and Flaring - Flaring - Combined	CO_2, CH_4, N_2O	1B2c2iii	1.B.2.C.2.i/ii	Flaring combined is split between oil (1.B.2.C.2.i) and gas (1.B.2.C.2.ii) and distributed in these 2 sectors
IE	1C2a Injection 1C2b Storage	CO_2	1C	1.B.2.C	Only emission from venting are estimated and thus, reported into 1.B.2.c

1.1.2 Industrial processes and product use (source category 2)

Table AX. 2. Description of the use of notation IE in the IPPU sector

Notation key	Source category	Components	Allocation as per IPCC Guidelines	Allocation used by Norway	Explanation
IE	2F3 Fire protection 2F4 Aerosols 2F5 Solvents	HFC	2F3 2F4 2F5	2F6	Emissions and activity data for are aggregated in 2F6 due to confidentiality

1.1.3 Agriculture (source category 3)

Table AX. 3. Description of the use of notation IE in the agriculture sector

Notation key	Source category	Components	Allocation as per IPCC Guidelines	Allocation used by Norway	Explanation
IE	3B5 Indirect N2O emissions	N_2O	3B5	3.D.2.1	The nitrogen model used for the estimations included emissions in Volatilized N from agricultural input. It shall be updated for next submission
IE	3D15 Mineralization/immobilization associated with loss	N_2O	3D15	LULUCF	It has been chosen to include these emissions in LULUCF

1.1.4 LULUCF (source category 4)

Table AX. 4. Description of the use of notation IE in the LULUCF sector

Notation key	Source category	Components	Allocation as per IPCC Guidelines	Allocation used by Norway	Explanation
IE	4A2 Biomass burning - wild fires	CH_4	4A2	4A1	

1.2 Not Estimated (NE)

1.2.1 Agriculture (source category 3)

Table AX. 5. Description of the use of notation NE in the agriculture sector

Notation key	Source category	Components	Explanation
NE	3A4 Other livestock – Other 3B4 Other livestock - Other	CH_4, N_2O	Since the number of animal from this category is very low, it has been decided to not estimate emissions from this category
NE	3B5 Indirect N2O emissions	N_2O	Due to lack of data, emissions have not been estimated. It should be included in the next submission
NE	3A Enteric fermentation 3B Manure management	NMVOC	Due to lack of data, emissions have not been estimated. It should be included in the next submission
NE	3D Agricultural Soil	CH_4, NOx, NMVOC	Due to lack of methodology and lack of data, emissions have not been estimated. NOx and NMVOC should be included in the next submission
NE	3I Other Carbon-containing Fertilizers	CO_2	No activity data is available for Other Carbon-containing Fertilizers. Therefore, emissions have not been estimated.

1.2.2 LULUCF (source category 4)

Table AX. 6. Description of the use of notation NE in the LULUCF sector

Notation key	Source category	Components	Explanation
NE	4A2 Biomass burning - controlled burning	CH_4	Emissions from controlled burning are considered negligible

1.2.3 Waste (source category 5)

Table AX. 7

Notation key	Source category	Components	Explanation
NE	5A1 Managed waste disposal site 5B Biological treatment of solid waste 5D1 Domestic wastewater	NOx, CO, NMVOC	Due to the lack of data available to implement methodologies, emissions have not been estimated.
NE	5C2 Open burning of waste	CO_2, CH_4, NOx, CO, SO2, NMVOC	Due to the lack of data available to implement methodologies, emissions have not been estimated.
NE	5D2 Industrial wastewater	N_2O, NOx, CO, NMVOC	Due to the lack of data available to implement methodologies, emissions have not been estimated.
NE	5D3 other	CH_4, NOx, CO, SO2, NMVOC	Due to the lack of data available to implement methodologies, emissions have not been estimated.

Annex XI: Reference versus Sectoral Approach - Quantification of differences

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 for work on this subject performed since NIR 2013.

Annex XI has not been updated with the current inventory and reflects the inventory that was submitted with the NIR 2014.

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 AX- 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 2012, the difference for CO_2 is 6.6 per cent. The large discrepancies are primarily due to statistical differences in the energy balance, as shown below.

Table AX- 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	**-12.7**	24 090	25 852	**-6.8**
1991	400	380	**5.2**	28 455	25 468	**11.7**
1992	379	387	**-2.2**	26 646	25 954	**2.7**
1993	378	403	**-6.3**	26 496	26 933	**-1.6**
1994	404	423	**-4.7**	28 646	28 333	**1.1**
1995	431	421	**2.3**	30 307	28 245	**7.3**
1996	397	459	**-13.5**	28 066	31 066	**-9.7**
1997	450	464	**-3.0**	31 704	31 153	**1.8**
1998	508	463	**9.7**	35 526	31 169	**14.0**
1999	566	463	**22.3**	39 883	31 431	**26.9**
2000	654	452	**44.7**	45 941	30 471	**50.8**
2001	611	478	**27.8**	41 695	32 545	**28.1**
2002	509	484	**5.2**	35 409	32 737	**8.2**
2003	546	504	**8.3**	37 797	34 098	**10.8**
2004	647	508	**27.3**	45 833	34 136	**34.3**
2005	598	500	**19.6**	42 584	33 867	**25.7**
2006	637	521	**22.3**	45 767	34 764	**31.7**
2007	501	528	**-5.3**	34 505	35 134	**-1.8**
2008	580	526	**10.3**	40 389	34 594	**16.8**
2009	555	539	**3.1**	38 872	35 063	**10.9**
2010	653	554	**18.0**	44 595	36 547	**22.0**
2011	547	537	**1.7**	37 996	35 585	**6.8**
2012	540	531	**1.6**	37 366	35 040	**6.6**

Source: Statistics Norway/Norwegian Environment 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 AX- 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 M in Table AX- 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 Annex XII.

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 the 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 AX- 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 AX- 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 feedstock”. 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 agent. 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: -30 PJ to200 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 Annex XII.

- 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: 2-5 PJ.
  - Burning off of coke in refinery crackers and related emissions. Range: 6-11 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. Range: -9 PJ to 13 PJ.

The analysis is summarized in Table AX- 3 below. The analysis in the CRF tables is shown in the left part. Further corrections are included in the following columns.

Table AX- 3 Overview over the Reference and Sectoral approaches for energy. PJ.

Unit: PJ	Consumption data from CRF Table1.A(c)					Additional adjustments in RA consumption			Remaining difference RA-SA	
	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	-6	-9	-2.3 %
1991	486	380	86	20	5 %	22	7	-6	-4	-1.2 %
1992	465	387	86	-9	-2 %	-9	10	-6	-3	-0.8 %
1993	470	403	93	-26	-6 %	-28	10	-6	-1	-0.1 %
1994	500	423	96	-20	-5 %	-20	7	-6	-0	0.0 %
1995	534	421	103	10	2 %	14	5	-7	-2	-0.6 %
1996	500	459	103	-62	-14 %	-59	5	-7	-2	-0.4 %
1997	564	464	114	-14	-3 %	-11	4	-7	0	0.1 %
1998	629	463	121	45	10 %	43	5	-8	4	0.9 %
1999	683	463	118	103	22 %	103	4	-8	3	0.7 %
2000	773	452	119	202	45 %	200	7	-9	3	0.7 %
2001	743	478	132	133	28 %	128	4	-9	11	2.3 %
2002	631	484	122	25	5 %	29	2	-9	3	0.7 %
2003	676	504	130	42	8 %	47	-1	-12	8	1.6 %
2004	776	508	129	139	27 %	150	0	-11	1	0.1 %
2005	721	500	123	98	20 %	109	1	-13	1	0.2 %
2006	756	521	119	116	22 %	126	-0	-13	3	0.6 %
2007	625	528	125	-28	-5 %	-27	6	-13	5	1.0 %
2008	711	526	130	54	10 %	62	3	-14	3	0.5 %
2009	666	539	111	17	3 %	25	4	-13	1	0.2 %
2010	769	554	115	100	18 %	95	6	-14	13	2.3 %
2011	667	537	120	9	2 %	16	5	-16	3	0.6 %
2012	656	531	116	8	2 %	15	5	-16	5	1.0 %

Source: Statistics Norway/Norwegian Environment 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 AX- 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 AX- 4)
c) Energy balance item "Losses"; petrol coke/CO gas burnt in refineries 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 AX- 4)
d) Other fuels are currently not included in the reference approach

The following Table AX- 4—Table AX- 8 show in more detail how the energy balances and the Reference and Sectoral approaches are related for the different fuel groups. Table AX- 4 is a combined table for liquid and solid fuels, in PJ. For natural gas there are Table AX- 4—Table AX- 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 AX- 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 AX- 4 Overview of discrepancies in energy goods. Solid and liquid fuels. PJ

	Consumption data from CRF Table1.A(c)			Included in RA, but not in the NIR energy balance				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							
Unit: PJ	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	Remaining difference RA-SA	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)	Remaining difference RA-SA
	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	286	77	11	-0	**10**	67	1	575	-	591	-15	-6	**-21**	88
1991	397	277	120	13	-0	**13**	107	2	545	-	573	-26	56	**30**	77
1992	357	277	80	12	-0	**11**	69	1	615	-	635	-19	7	**-12**	81
1993	357	287	70	13	-1	**12**	57	1	613	-	640	-26	-6	**-32**	89
1994	397	299	98	15	-3	**12**	86	2	633	-	664	-29	23	**-6**	92
1995	407	295	112	14	-4	**10**	102	2	583	-	603	-18	26	**8**	94
1996	392	324	67	17	-5	**12**	55	1	648	-	678	-28	-13	**-41**	96
1997	404	318	86	16	-7	**9**	77	2	655	-	679	-22	-0	**-22**	99
1998	441	322	119	16	-6	**10**	109	2	641	-	651	-8	17	**10**	100
1999	505	329	176	15	-7	**8**	168	2	658	-	682	-22	95	**73**	95
2000	582	298	284	13	-6	**7**	277	2	656	10	669	-1	178	**177**	100
2001	458	309	149	12	-8	**5**	144	1	616	11	627	1	34	**35**	109
2002	433	308	124	13	-10	**3**	121	1	579	11	601	-9	24	**14**	107
2003	435	317	118	13	-13	**-1**	119	1	645	12	670	-12	22	**10**	109
2004	589	312	277	14	-12	**2**	275	2	619	11	648	-17	189	**172**	103

2005	538	306	233	15	-12	**3**	230	1	681	11	713	-20	151	**131**	99
2006	555	319	236	15	-13	**2**	234	2	718	13	754	-21	158	**138**	96
2007	396	319	78	17	-7	**11**	67	2	713	11	747	-20	-17	**-37**	104
2008	480	308	173	16	-8	**8**	165	2	660	11	693	-19	82	**63**	102
2009	446	306	139	18	-9	**9**	130	2	665	10	699	-22	64	**42**	88
2010	462	319	142	15	-8	**7**	135	3	631	11	666	-21	57	**36**	99
2011	454	313	140	17	-8	**9**	131	3	703	11	735	-19	52	**34**	97
2012	434	309	126	17	-8	**9**	117	3	696	10	721	-13	33	**20**	97

Source: Statistics Norway/Norwegian Environment Agency

Table AX-4 ***continued****. 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**	-7	-2.3 %
1991	2	41	6	32	**81**	-4	-1.4 %
1992	3	42	8	32	**84**	-3	-1.2 %
1993	3	50	8	29	**90**	-1	-0.3 %
1994	3	52	7	29	**91**	1	0.3 %
1995	3	53	6	36	**97**	-3	-1.0 %
1996	3	53	7	33	**96**	-0	-0.1 %
1997	3	56	8	33	**100**	-1	-0.3 %
1998	3	52	8	36	**100**	-0	-0.1 %
1999	4	49	7	35	**95**	-0	-0.1 %
2000	3	49	10	37	**100**	-0	-0.2 %
2001	4	65	8	32	**108**	1	0.2 %
2002	3	67	9	25	**104**	3	0.9 %
2003	2	68	10	25	**105**	3	1.1 %
2004	3	57	9	31	**100**	2	0.8 %
2005	2	59	11	24	**96**	3	1.0 %
2006	2	59	11	21	**92**	4	1.2 %
2007	3	65	10	23	**100**	4	1.2 %
2008	3	64	8	25	**99**	3	0.9 %
2009	3	57	10	15	**85**	4	1.2 %
2010	4	58	10	21	**93**	6	1.9 %
2011	3	57	10	22	**93**	5	1.5 %
2012	3	56	10	22	**92**	5	1.6 %

Source: Statistics Norway/Norwegian Environment Agency

Note to Table AX- 4: The correction for ”non-energy use and feedstock” in the CRF includes items D, Q, and S in the table.

Natural gas

Table AX- 5— Table AX- 7 that follows are simpler than Table AX- 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 AX- 5. The primary data are usually by volume, and this approach avoids problems with finding the correct NCV values.

The following columns in Table AX- 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 AX- 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 AX- 5.

Calculation notes to Table AX- 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 AX- 5 Overview of discrepancies on energy goods. Natural gas. Million Sm³

	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 m³	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 m³	% 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	5 553	26	20	-467	520	73	-47	-0.9 %
2010	7 803	5 587	2 217	15	1 648	544	2 207	9	0.2 %
2011	5 396	5 284	112	15	-498	591	108	4	0.1 %
2012	5 590	5 211	379	25	-154	514	385	-6	-0.1 %

Source: Statistics Norway/Norwegian Environment Agency

Table AX- 6 Overview of discrepancies on energy goods. Natural gas. PJ

	Consumption data from CRF Table1.A(c)			Included in RA, but not in SA. Data from NIR energy balances				Remaining difference RA-SA	
Unit: PJ	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	-2	-0.7 %
2010	307	220	87	1	59	19	79	8	3.8 %
2011	213	208	4	1	-18	21	4	1	0.3 %
2012	221	206	15	1	-5	18	14	1	0.7 %

Source: Statistics Norway/Norwegian Environment Agency

Table AX- 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 AX- 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 an even higher energy and carbon content than the factors used. See Table AX- 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 AX- 7:

CO_2 emissions corresponding to the correction items are calculated using NCV and C content values of the energy balance.

Table AX- 7 Overview of discrepancies on energy goods. Natural gas. Gg CO_2

Unit: Gg CO_2	Emission data from CRF Table1.A(c)			Included in RA, but not in SA				Remaining difference RA-SA	
	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	11 601	486	53	595	-	648	-162	-1.4 %
2008	11 827	11 787	41	26	-30	-	-5	45	0.4 %
2009	11 546	12 456	-910	39	-937	-	-898	-12	-0.1 %
2010	16 495	12 777	3 719	31	3 313	-	3 344	375	2.9 %
2011	10 944	12 166	-1 223	30	-998	-	-968	-254	-2.1 %
2012	11 629	11 908	-279	49	-306	-	-257	-23	-0.2 %

Source: Statistics Norway/Norwegian Environment Agency

Table AX- 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 AX- 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 AX- 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	16.08
2008	35.75	39.88	15.34	15.80	15.69
2009	35.72	39.50	15.34	15.76	15.49
2010	35.74	39.36	15.34	15.75	15.85
2011	35.64	39.43	15.33	15.75	15.93
2012	35.46	39.61	15.31	15.77	15.73

Source: Statistics Norway/Norwegian Environment Agency

Annex XII: Quality controls within reference and sectoral approach – NIR 2015

Project report 2013-2014

Contents

1 Abstract

For several years there has been a problem regarding statistical difference between Norwegian emissions of carbon dioxide (CO_2) estimated from reported emissions and the combustion of fossil fuels (sectoral approach) and emissions estimated from the supply-side (reference approach). This should not be unexpected from a country exporting over 90 per cent of its unrefined petroleum production. However, there has been a tendency for a positive bias in this statistical difference, which has caused uncertainty whether the Norwegian greenhouse gas emissions might have been underestimated.

The UN expert review teams (ERTs) have repeatedly questioned the quality of the Norwegian emission inventory because of this bias, and in 2012/2013 Norway carried through a project, led by Statistics Norway, that concluded with annex XII to the 2013 national inventory report (NIR). This report is a follow-up of the 2013 report. Statistics Norway by the Division for energy and environmental statistics has led the work, and financial resources have been provided by the Norwegian Environment Agency and Statistics Norway in a joint venture.

The detangling of the energy balance is a complex task because of complex product streams, and the availability of alternative data sources is limited. To optimize the use of resources within the frame of the project, some strategic decisions were made:

1. Focus on statistical differences in the energy balance.
2. Cover liquid and gaseous fossil energy carriers only.
3. Develop more detailed energy balance, both vertically (i.,e. between products) and horizontally (i.e. between primary and secondary production) to increase transparency.
4. Compile energy balances based on two alternative input data for export.
5. Focus on products showing a positive statistical difference.
6. Give priority to one reference year, which was 2011.

In addition to the data sources used in the official energy balance, this project made special use of production and shipment data from the Norwegian Petroleum Directorate (NPD), detailed micro data from the statistics on external trade (ETS), a specially reported refinery mass balance, and specially reported data on export from a pre-refinery pretreatment plant. The NPD shipment dataset was equipped with an additional variable called *destination*, which proved particularly helpful.

In this project, several causes to statistical differences in the energy balance were found and quantified. The findings were implemented in two alternative detailed energy balances developed in this project, applying export figures from NPD and ETS respectively, and new statistical differences were calculated and compared with the ones following from the official energy balance. All findings leading to corrections regarded the reference approach, while all findings regarding the sectoral approach confirmed the official energy balance.

The overall sum of statistical differences was reduced from 429 ktoe to -743 ktoe, or -0.3 per cent of the total supply, when using NPD as data source for export data and making adequate corrections. This does not immediately look like an improvement. However, when dissecting the data, primary products apart from dry gas show a probable reduction in statistical difference from 1 410 ktoe to 207 ktoe, or 0.2 per cent of the corresponding supply, which is a substantial advance. Due to uncertainty in the correction of crude oil, this revised statistical difference might be as high as 872 ktoe.

Even this is a substantial advance. When using ETS export for all these products, the statistical difference increased to 2 505 ktoe, even after all other corrections were made. Natural gas (dry gas) and secondary products showed negative statistical differences. Only two minor corrections were made for these product types, as no alternative data sources were available.

The main findings explaining statistical differences in the official energy balances were:

- Export figures based on the NPD shipment database give consistently lower (i.e. improved) statistical differences. This suggests that the ETS export data might be somewhat incomplete. The correction being performed in the official energy balance, by replacing ETS export of condensate with NPD export, is a clear improvement but somewhat imperfect.
- As much as 4 302 kt crude oil, 796 kt LPG/NGL and 86 MSm^3 LNG must be added to the NPD export, in order to obtain completeness. These are shipments recorded with Norway as destination country, but with characteristics and/or alternative data showing that the final destination is, or probably is, in a foreign country. As mentioned above, the correction of crude oil contains uncertainty.
- Correction must be made in the NPD export due to LPG production being classified as gasoline.
- The fractionation of gasoline/NGL into butane and propane in one pre-refinery pretreatment facility has been missing since the establishing of the plant in 1999, but is partly corrected for in the official energy balance.
- Unsaturated hydrocarbons like propylene are produced at the refineries and included in the reported LPG production. Domestic use of such products as raw material in manufacturing of for instance plastics is not included in the energy balance, and this might cause a positive statistical difference of up to about 200 kt in the LPG/NGL product category. A correction is not made, as further investigation is needed.
- The choice of energy conversion factors (NCVs) and carbon content factors on statistical differences and RA/SA differences are very unlikely to be the cause of major statistical differences in the energy balance and in the RA/SA analysis.

Extensive studies of the ETS data have been done as part of this project, including comparison of single shipments with the NPD export, comparison by enterprise with the production of different petroleum products, and a check for completeness as regards oil and gas fields sending their well streams directly to foreign destinations. The scrutinizing of the ETS is not finished, and will be described more thoroughly in a follow-up report later this year, together with further work on the crude oil correction, natural gas and some other remaining tasks.

2 Introduction

2.1 Background

For several years there has been a problem regarding statistical difference between Norwegian emissions of carbon dioxide (CO_2) estimated from reported emissions and the combustion of fossil fuels (sectoral approach) and emissions indirectly estimated from the supply-side (reference approach). This should not be unexpected from a country exporting over 90 per cent of its unrefined petroleum production. However, there has been a tendency for a positive bias in this statistical difference, which has caused uncertainty whether the Norwegian greenhouse gas emissions might have been underestimated.

The UN expert review teams (ERTs) have repeatedly questioned the quality of the Norwegian emission inventory because of this bias, and in 2012 there was a strong call for explanations and/or improvements. In response to this, Norway carried through a project, led by Statistics Norway, that concluded with annex XII to the 2013 national inventory report (NIR 2013). The annex describes improvements, as well as unsolved issues left to further work. The ERT accepted the report at the 2013 review, but *"...recommends that Norway, in its 2014 annual submission, transparently and comprehensively report on the outcomes of the QC checks carried out for both the sectoral and the reference approaches and for all fuel groups (i.e. solid, liquid and gaseous). The party is recommended to further improve the accuracy of the data collection procedures for oil and gas production, processing and export in order to further reduce the level of differences between the sectoral and reference approaches"*

This report is a follow-up of the 2013 report, in which progress and conclusions on remaining issues from the previous report are described. As the remaining issues mainly concerned the reference approach, this has been the main focus also in this report.

The report provides energy balances with more detailed schemes, and alternative energy balances for primary petroleum products based on two different data sources for export. Furthermore, it provides description of current findings, data and methods leading to main findings, and conclusions on how our findings affect the statistical difference between the supply and use of petroleum products, which corresponds to the reference and sectoral approach respectively. Finally, it describes the need for further work.

2.2 Institutional arrangements

Statistics Norway holds the overall responsibility for the level of the statistical differences in the energy balance. The Division for energy and environmental statistics has led the work with quality controls and contact with other institutions, and the work has included close contact with the Division for external trade. A temporary formalized cooperation between the Division for energy and environmental statistics and the Division for external trade is now established. Because of the im-

portance of the energy balance in the national emission inventory, the Norwegian Environment Agency has also been involved in the process of quality controls.

Financial resources have been provided by the Norwegian Environment Agency and Statistics Norway in a joint venture.

The different tasks within the project have mainly been undertaken by informal contact between personnel at the Division for energy and environmental statistics at Statistics Norway and relevant collaboration partners, including the Norwegian Petroleum Directorate (NPD), Gassco AS, one refinery and the Division for external trade at Statistics Norway. There has also been held one meeting between Statistics Norway and NPD, and currently a colleague from the Division for external trade is working at the Division for energy and environmental statistics in a 20 per cent exchange position, partly with issues related to the energy balance.

Work on topics related to this project has been carried out in separate projects. These include 1) the consistency between the energy account, the emission account and the national account, 2) creating a new IT platform for the energy balance, and 3) the establishment of an annual statistic on delivery (i.e. sale) of petroleum products, which is an improvement of the previous summing up of the monthly statistics. These projects are not initiated in order to improve the energy balance, but imply reviews of the consistency and quality of the energy balance that may lead to improvements of the statistical differences as well. These projects were not finished within the course of this project, but brief statements from the projects are given in this report.

2.3 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 relation 1 to 3 containing the highest amounts of fossil energy carriers are by far production and export. The main element in the SA relation is end use, in which the statistics on delivery of petroleum products are the main data source.

It should be noted that losses *within a transformation process* do not generate statistical differences (SD) (see below).

2.4 Measuring units and conversion factors

Several measuring units are frequently used when presenting energy balances and statistical differences. In this report the different product amounts are given in metric kilotons (kt), except natural gas (incl. LNG) that is given in million standard cubic metres (MSm^3). When adding the products to-

gether, metric kilotons of oil equivalents (ktoe) is used. The table below shows the conversion from ktoe to the different product amounts in kt and MSm^3, in addition to petajoule (PJ) and terawatt hours (TWh):

Table AXI- 1 Conversion factors for product amounts from ktoe to kt, MSm^3, PJ and TWh

Measuring unit	Conversion factor
kt of condensate	1
kt of NGL/LPG	1
MSm3 of natural gas	1
kt of CO_2	3.15
PJ[1]	0.0423
TWh[1]	0.0118

[1] On average. The real values vary slightly between the different products.

1 PJ corresponds to about 24 ktoe, and 1 TWh corresponds to about 85 ktoe.

3 Resolutions and priorities

At the 2012 review, the expert review team (ERT) pointed at an abrupt change in statistical differences around 1999/2000. As a response, the previous project investigated if there were any structural changes taking place around these years. One obvious event was the establishment of a pretreatment facility in connection with a refinery in 1999. The material flows between three involved terminals, the pretreatment facility and the refinery are complex, but no lacks or errors in the energy balance, due to this complexity, had so far been discovered. Another historical event was the establishment of Gassco AS, a non-profit company administering most of the Norwegian natural gas pipelines on behalf of the oil companies. The data reporting on gas from the oil companies might have been impaired the first year after Gassco's establishing (i.e. for the last reference year before Gassco AS took over the reporting responsibility), as a one-time incident.

The Norwegian position has been that a high statistical difference must be expected and tolerated, as a result of high production and export of petroleum products and a comparatively very low domestic consumption. Despite this Norwegian position, Norway acknowledges a considerable self-interest in improving the energy balance, and hence reducing the statistical differences, if possible. Much effort has been put into this earlier (NIR 2012, NIR 2013), but some fundamental inconsistencies have remained unsolved. In order to progress in detecting causes to statistical differences, new tools had to be applied. The most important ones were the collection of new data from NPD and one refinery, more extensive use of micro data from the external trade statistics (ETS), and the formalized collaboration with the Division for external trade, as well as a new and very detailed setup of the energy balance was developed for selected products.

3.1 Main decisions

The detangling of the energy balance is a complex task because of the complexity of the product streams involved. Furthermore, the availability of alternative data sources is limited. To optimize the use of resources within the frame of the project, some strategic decisions and priorities were made.

Main focus on statistical difference in the energy balance. As the statistical differences in the energy balance comprise the main causes to deviation between the sectoral and reference approaches, this report is built up around the work done and the findings made in this project regarding the energy balance. Additional work on conversion factors in the reference approach and on use of data on CO_2 quotas in the sectoral approach is presented in own sections in chapter 7, while status reports from related projects are provided with an own chapter 8.

Liquid and gaseous fossil energy carriers. In this project only liquid and gaseous fossil energy carriers are covered, as these have shown the highest unexplained statistical differences (NIR 2013). Both refined and unrefined products are included, but for refined products the project work is still going on and further results are expected.

More detailed energy balance, both vertically and horizontally. To increase transparency, the categories of liquid and gaseous fossil products in the energy balance were vertically split into more detailed products. The split is even more detailed than suggested in the previous report. Furthermore, a horizontal split between primary and secondary products was elaborated, as well as a separate balance for the refineries.

One additional reason for the horizontal split was that errors affecting the estimation of greenhouse gas emissions normally appear as statistical differences in the secondary products' balance only. This, of course, depends on the refinery statistics being reliable, which is the main reason why we elaborated a separate balance for the refineries as a quality check.

Some minor use of primary petroleum products outside the refineries occur. Hence, errors affecting the estimation of greenhouse gas emissions are not totally ruled out from the primary products' balance.

Two alternative input data for export and total produced amounts of primary petroleum products in the energy balance. As suggested in the previous report (NIR 2013, Annex XII), the export data from the Norwegian Petroleum Directorate (NPD) has been used, with some adjustments, instead of export data from Statistics Norway's external trade statistics, as input data to an alternative detailed energy balance. The NPD export data are part of a dataset covering all initial shipments[1] of Norwegian primary petroleum products, except natural gas transported by pipeline. Statistical differences are calculated for the two alternative methods, with adjustments for findings made in this project, and both are compared with the detailed statistical differences estimated from the latest published energy balance figures.

There is an ongoing work scrutinizing the quality of the ETS export and import of petroleum products. There are some indications of imperfect quality when inspecting the data at a detailed level

[1] I.e. shipments from producer's sales point, which can be a platform, production ship, Norwegian terminal or foreign terminal (UK or Denmark).

(see below), but not enough to conclude. Therefore, with some exceptions, in the energy balance setup with ETS export and import data, the ETS export and import data are used without corrections. [Conclusions from this work are expected in September this year.]

Focus on product categories showing a positive statistical difference. A positive statistical difference in the energy balance usually indicates there is a part of the production of fossil fuels that cannot be accounted for. This could in turn be a result of fossil fuel consumption not covered by the energy statistics, and hence neither by the emission statistics. An underestimation of the greenhouse gas emissions means that Norway could break the international emission obligations without it showing in the emission statistics, and hence positive statistical differences is prioritized.

A negative statistical difference indicates imperfect quality in the energy balance, but is not linked to underestimation of greenhouse gas emissions. Hence, in this project lower priority is given to product categories showing a negative statistical difference in this project. It might, however, indicate overestimation of Norwegian greenhouse gas emissions, which may increase the amount of CO_2 quotas that Norway need to buy in order to meet international commitments and/or the amount of CO_2 reducing efforts to be financed. Thus, eliminating negative statistical differences is of importance nationally.

Priority to reducing statistical difference in one reference year. By prioritizing improvement of one reference year, 2011, instead of improving of the whole time series, more efforts could be put into unraveling the mechanisms leading to statistical differences, and possibly poor quality, in the emissions estimations. Implementation of the findings into the whole time series could then be performed later, as part of the regular statistical work. One unfortunate consequence is that diagrams showing time series of the statistical differences due to our new findings can not be provided in this report. The reason for choosing 2011, instead of for instance 2012, was that the official energy balance for 2011 was ready when the project started in April 2013[2], and that some alternative data that need special programming were not available for 2012.

4 Data sources

The ordinary data sources from NPD and ETS are well described in the previous report, and are just briefly described here. For other data sources used in the official energy balance, see documentation from Statistics Norway (2013a). There were also collected some new data ad hoc in this project, which are described below.

4.1 NPD production data and shipment data

The production data displays net amounts of produced petroleum by field, month and product, i.e. saleable amounts. The shipment data displays each single shipment, including its destination country, except natural gas in gaseous state (dry gas). There is a thorough quality check before the data

[2] The final version, containing minor revisions, and which this report base on, was ready in November 2013

are delivered to Statistics Norway. Shipments with a foreign destination country are called NPD export in this report. The shipment data contain information identifying each single delivery (cargo number, shipment date, owner s, etc.), which can be used for detailed quality checks. The amounts are given in mass and volume units according to the products' liquid phase, except for LNG/natural gas where volume in gaseous state is given. The (net) production data and the NPD export data are measured at the delivery (i.e. sales) point. There is a minor time lag, as production is measured per month while NPD export is measured at the shipment day.

The two datasets are compared on total levels in an overall consistency check. Differences are explained by stock changes and time lags. However, in this project this quality control has been improved in order to eliminate the effect of random variation, and indications of inconsistency in one particular period are found. Apart from this overall control, effort has been put on revising the production data by using statistical techniques[3]. However, as the production may vary greatly by month according to planned shut-downs for maintenance and difficult production conditions, this approach proved unsuccessful. It is still seen as unsatisfactory not to control such important data for outliers in a statistical way, and an improved approach where known deviations are being labelled in the delivered data should be considered.

The shipment dataset contains information on origin and destination country of the first delivery in the delivery chain, but does not trace the product streams beyond that. As demonstrated in this project, there are cases where the export occurs after the first delivery and/or destination country and destination are inconsistent. Origin in the shipment data refers to site of shipment, i.e. production field or terminal.

In two cases the two NPD datasets classify a petroleum product differently:

1. The production at four fields, landed at one Norwegian terminal, which is classified as NGL in the production data, is in the shipment data classified as condensate.
2. The production at two fields, landed at one Norwegian terminal, which is classified as LPG in the production data, is in the shipment data classified as gasoline. This shift in classification was discovered during the current project.

Statistics Norway gets data from the NPD for the final energy balance in September/October, but some minor revisions in NPD's master dataset might be done after that. Keeping track of versions is therefore of importance.

[3] A technique of estimating the absolute difference from the mean, raised to a variable (but universal) power, was used for 1) the production of a certain product type at a certain field in a certain month against the mean for all months, and 2) the average monthly production of a certain product type at a certain field against the previous year. The variable power allows making a due weighting of absolute differences versus relative differences. The limit value deciding which fields and months to revise was set by judgement, in order to obtain an adequate accuracy and a reasonable number of fields to revise.

4.2 Shipment data containing destination site

A specially programmed query from NPD's master shipment dataset was delivered to Statistics Norway in March 2013, just before the finalization of the previous project. The dataset resembles the ordinary shipment datasets, but contains one additional variable, destination site (called *destination* in the dataset). This variable contains information about landing sites, which proved very useful in this project in detecting patterns in the shipments that reveal causes of statistical differences. This variable was also essential in quantifying the correction of the NDP export of crude oil. The dataset covers the period 2008-2011.

The extraction of the augmented shipment data from the master database needs special programming. A new database solution in NDP is scheduled to be up and running around 2015, and a routine delivery from NPD to Statistics Norway is not foreseen until then.

As mentioned before, the NPD shipment data does not contain dry gas. Hence, a request was sent to Gassco AS for a similar dataset covering detailed data on dry gas. The received data were on a more aggregated form than the shipment data, and hence not adequate for this project. More detailed data are also available. However, these data contain information on ordered amounts of energy per destination site (exit point) and company, but not actually delivered physical amounts (Sjøen, pers. comm. 2013). The link between ordered amounts of energy and delivered physical amounts is not straight forward. Due to a negative statistical difference for natural gas, this track was given a lower priority (see below) and left to further work.

4.3 ETS export and import data

The external trade (ETS) export data are compiled from different data sources, as described in the previous report. Data on crude oil and natural gas being exported outside the Gassled pipeline network are collected from the oil companies, data exported through Gassled is reported from Gassco AS, and all other export and import of petroleum products is reported on custom declarations via Norwegian Customs and Excise. The data are thoroughly revised at Norwegian Customs and Excise and Statistics Norway. The data processing and revision are described in a standard quality report ('about the statistics') following the official statistics (Statistics Norway 2014a).

There are some risks of error specific for the export data on petroleum products. 1) Data from different sources are sewed together in order to cover the total export. As a result, misclassification in the original data may potentially lead to under or over coverage (see previous report for details). The different commodity codes have quite technical descriptions, with rather similar-looking significations, so this is a significant risk. 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 previously missing in the ETS. 3) Some petroleum streams have different measuring points in the NPD production data and the ETS export data, i.e. unstabilized crude oil and rich gas landed in UK. In the energy balance these streams are manually split into the different petroleum products as reported from the NDP, and in case of new product streams a risk of missing correction occurs. 4) The final ETS export figures are released in May the next year. Any corrections in the NPD data after that time might lead to statistical differences. The import data do not contain any of these risks.

The form of the ETS data is different from the NPD data, and hence they are not easily controlled against each other. However, the ETS micro data contain information on exporting enterprise and site of exportation, which have been exploited in this project. Comparisons based on these data are probably too tedious for routine revision, but proved helpful in this project and will be used in a continued scrutinizing of the ETS data.

The ETS export and the NPD data are, except for unstabilized crude oil and rich gas landed in UK, measured at the same point, i.e. the delivery point[4].

4.4 Refinery mass balance

According to the regular refinery statistics, which base on monthly reporting from the refineries, there is an unexplained discrepancy between the use of raw materials (feed stock and blend stock) and the produced amounts. A report from the refinery in question, showing the whole mass balance for 2011, was specially delivered for this project. The report shows the regular production, along with the residuals produced and an estimated loss. The loss is estimated as a residual from the mass balance.

In this project a new total mass balance for refineries, applying the special report from the corresponding refinery, was elaborated.

4.5 Export from a refinery pretreatment plant

In the course of the project, indications pointed towards the occurrence of direct export of fractionated products from a refinery pretreatment plant, which were neither covered by the refinery statistics nor the energy balance. To confirm and quantify this export, a request was sent to the refinery, and a detailed report was returned. This report contained data on amounts delivered from the pretreatment plant, in addition to product type, date of delivery, name of vessel, cargo number and an abbreviation of the producing field. For deliveries to the refinery, the abbreviated field name was replaced with an abbreviation of the refinery name. The amounts were given in tonnes.

5 Statistical differences in the official energy balance – selected products

In the final official energy balance for 2011, published in November 2013 (Statistics Norway 2013a), the findings described in the previous report (NIR 2013) and some early findings from this project are implemented. Only minor revisions were made to the preliminary energy balance published in November 2012, on which the previous report built. The final official energy balance for liquid and gaseous fossil energy carriers is presented in figure AXII-1:

[4] When it comes to transportation costs, the measuring point in the ETS is at the national border.

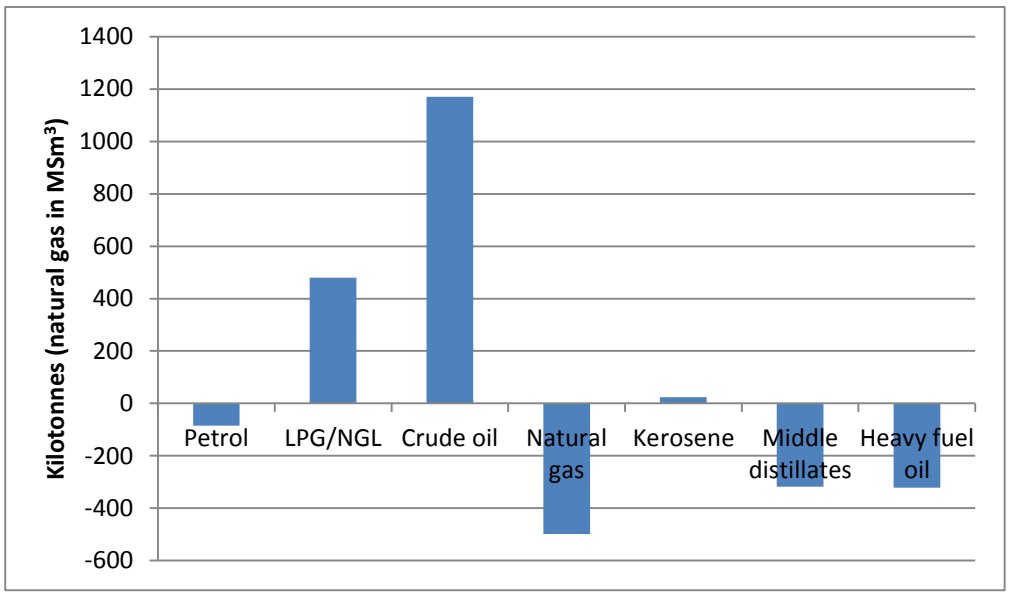

Figure AXI- 1 Statistical differences in the official energy balance for 2011, by main product category.

As the figure shows, the official energy balance still contains significant statistical differences. There are positive differences for crude oil, NGL/LPG and kerosene, and negative differences for petrol, which includes condensate and partly NGL, for natural gas and for most of the refined products. The overall statistical difference is positive by 452 ktoe. As explained before, positive statistical differences are the most serious ones as regards the use of the reference approach in greenhouse gas calculations.

There have previously been large and increasing problems with high statistical differences for condensate (NIR 2013, Annex XII), which are now apparently solved in the official energy balance. However, as described below, the approach in the official energy balance still contains some lacks and inconsistencies. These lacks and inconsistencies are partly responsible even for the positive difference for LPG/NGL.

No findings made after the answers to the ERT autumn 2012 are implemented in the official energy balance.

6 Findings and main results regarding the energy balance

6.1 Main results

The detailed setup of the energy balance and the presence of alternative data sources proved useful in discovering lacks and inconsistencies in the energy balance. Figure AXI- 2 shows the statistical differences for main primary product categories according to the final official figures along with the revised figures compiled in this project. A more detailed figure is provided in chapter 7, as well as a figure of statistical differences for detailed refined products. Chapter 7 also provides a more detailed description of some of the issues mentioned in chapter 6.

It should be noted that for most natural gas (i.e. in gaseous state) and for refined products no NPD export data exist. Furthermore, the statistical difference for crude oil estimated by using the NPD export data must be regarded uncertain, as some clarification still remains (see below).

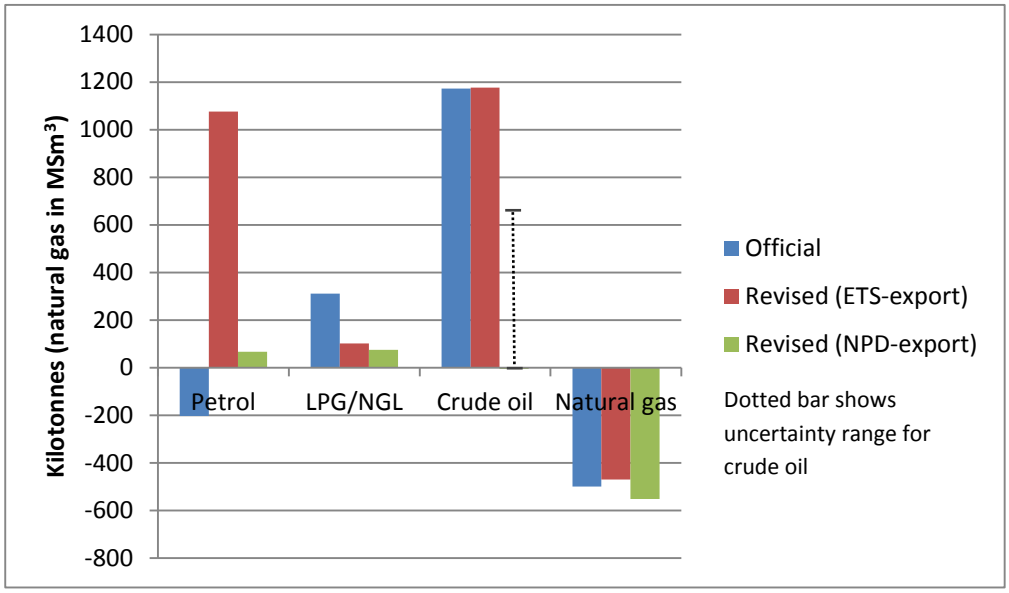

Figure AXI- 2 Statistical differences by main primary product categories in 2011. Final official and revised energy balances.

6.2 Summary of findings

Findings leading to corrections of the statistical difference

1. The export according to NPD differed significantly from the ETS export for most of the products being covered by both data sources, both at detailed and aggregated level. For crude oil the difference might have been as much as 1 179 kt. The overall difference for primary petrol products was 1 008 kt, even after taking into account the classification of condensate as refined naphtha. This is partly corrected for in the official energy balance, by replacing ETS export of condensate with NPD export of condensate. For LNG a difference of 82 MSm^3 is observed, while for primary LPG/NGL the difference was 27 kt.
2. As much as 4 302 kt crude oil, 796 kt LPG/NGL and 86 MSm^3 LNG must be added to the NPD export, in order to obtain completeness. These are shipments recorded with Norway as destination country, but with characteristics and/or alternative data showing that the final destination is, or probably is, in a foreign country. The correction of crude oil contains uncertainty (see section 7.2).
3. An assumption was made in the revised energy balance using ETS export that the amount of exported naphtha exceeding the amount of naphtha produced at the refineries (730 kt[5]) is actually unrefined condensate products. This is justified as no use of naphtha in chemical industries except refineries is reported to Statistics Norway in the manufacturing energy and

[5] Adjusted for stock changes.

raw material survey. Furthermore, the classification of unrefined condensate products as naphtha is known to occur in the ETS export, and incidents were observed in the ETS micro data as naphtha was apparently exported from oil companies not owning a refinery. In the official energy balance the exported condensate according to ETS is replaced with the NPD export of condensate, without taking into account condensate misclassified as naphtha.

4. The fractionation of 796 kt NGL and gasoline into butane and propane in a pre-refinery pre-treatment process is not covered by the refinery statistics, and hence not included in the official energy balance. However, of this 372 kt gasoline, according to the NPD shipment data, are classified as LPG in the production data. Hence, the net fractionation of NGL or gasoline was 424 kt. Moreover, the reclassification of 372 kt LPG into butane or propane needed to be specified, in order to avoid statistical differences at a detailed level. These transfers have in this project been recorded in the conversion post. In the official energy balance the approach was to classify half the produced NGL (602 kt) as petrol and half as LPG/NGL, based on information from NPD, and to omit the fractionation step.
5. A correction step in the energy balance takes into account that oil and gas being brought to shore in UK is classified in inconsistent ways in the NPD production data and the ETS export data. In the NPD production data the different NGL products are separated from oil and gas, while this is not done in the ETS export. Three minor petroleum fields were missing in this correction step in the official energy balance, of which two were landing only parts of their production in UK. The correction in the two revised energy balances amounts to 9 kt (5 MSm^3) gas and 2 kt oil. The problem is omitted when using export figures from NPD.
6. One commodity code in the ETS normally used for LPG/NGL gases (HS 27111900) is in certain cases used for LNG. A correction of the export figures, in order to move the LNG from LPG/NGL to natural gas, is made in the energy balance. However, in the official energy balance the correction term has MSm^3 as measuring unit even for the subtraction from LPG/NGL, while LPG/NGL is given in kt. This leads to an underestimation of the export by 15 kt. The problem is omitted when using export figures from NPD.
7. Export of LNG is given in mass units in the ETS, and has to be converted to volume. A correction factor of 1.36 MSm^3/kt is used in the official energy balance, while according to the NPD export data the factor should be 1.3524 MSm^3/kt. The difference in estimated export of LNG is 24 kt, and suggests that yearly factors should be estimated. The problem is solved “by itself” when using export figures from NPD.
8. Import to one enterprise of 66 kt of commodities is ethane according to the commodity text and saturated acyclic hydrocarbons according to the commodity code (HS 29011000). This code is normally used for iso-butane in the ETS, and thus a correction is made in order to increase clarity in the revised detailed energy balances.
9. The production of crude oil in the revised energy balances is 5 kt higher than in the official version, due to the use of different versions of the production data set in different statistics. It is not obvious which version is correct. The one not used in the official energy balance, but in the annual oil and gas statistics (Statistics Norway 2013b), is used in the revised version to display the inconsistency.

Main findings confirming data and methods in the official energy balance:

10. About 600 MSm^3 natural gas sent to the mainland each year and used as raw material in the manufacturing of methanol have previously been missing in the NPD production data. However, this has been corrected from the reference year 2010 onwards, and the corresponding production figures for 2011 is therefore correct. One more reference year (2007) has been corrected as well, but not the whole time series.
11. The amount of primary LPG shipped to Rafnes can be read from the NPD shipment dataset. In the revised energy balance this data source is used as input data for LPG being used as raw materials and fuel in factories in the Rafnes area. The difference from the official energy balance is small (within appr. 10 kt), though as not the same reference year were readily available for all data sources no exact calculation could be made within the frames of the project.
12. Dry gas contains about 15 per cent ethane and heavier petroleum gases. It has been confirmed by Gassco that none of this gas is allocated back to the producing fields in the production data. This is consistent with the rest of the energy balance.
13. It has been checked that 228 MSm^3 dry gas sent to one particular power plant is included in the production data. It should be checked that the remaining power plants fired by natural gas and LNG producing plants are included as well.
14. There has been uncertainty whether 241 kt fuel gas used in manufacturing in the Rafnes area should be classified as LPG/NGL or 'Other gas'. Comparing fuel gas and gas used as raw material with shipments of LPG/NGL products to Rafnes in the NPD shipment data show that the fuel gas should be classified as LPG/NGL, in line with the official energy balance.
15. Up to 2011 the amount of natural gas reinjected in one particular field was included in the production data, and needed to be corrected for. The reason why this gas was included in the production data, was that it was produced at other fields and sold to the field in question. It was discovered during the project that other similar cases existed and needed to be checked out. NPD was contacted, and it appeared that no other reinjected amounts were included in the production data.

Other findings that may influence on the statistical difference:

16. The production of crude oil exceeded total NPD shipments by 414 kt, when stock changes were corrected for and December was used as reference month for last 12 months' production, shipments and stocks. However, the picture varies significantly according to which month is used as reference month. If we look at January 2012, the difference was even larger, but for March 2012 the shipments were the largest, by 29 kt. This suggests the presence of time lags that are not accounted for in the stock statistics. For second half-year of 2010 the comparison of production with shipments and stocks displayed a fast increasing and large discrepancy (see below). Note that time lags cause random statistical differences, but no bias.
17. Total LNG production, according to the NPD production data, exceeded total NPD shipments by 62 MSm^3. These amounts should be the same, as the stock changes are estimated to 0 in the energy balance.
18. The ETS export micro data indicate that unsaturated hydrocarbons like propylene and ethylene are produced at the refineries. The refinery statistics are not sufficiently detailed to an-

swer to this, but for the one refinery in question the overall production of gaseous saturated and unsaturated hydrocarbons amounted to 374 kt[6], while the export of unsaturated hydrocarbons was between 131 kt and 204 kt. Domestic use of such products as raw material in manufacturing of for instance plastics is not included in the energy balance, as they are not combusted, and this might cause a positive statistical difference of up to about 200 kt in the LPG/NGL product category. No correction is made, as further investigation is needed. It should be noted that all the unsaturated hydrocarbons are exported with the commodity code 27111400, which is covered the energy balance, and not for instance 29012200, which is not covered.

19. Extensive studies of the ETS data have been done as part of this project, including comparison of single shipments with the NPD export, comparison by enterprise with the production of different petroleum products, and a check for completeness as regards oil and gas fields sending their well streams directly to foreign destinations. The scrutinizing of the ETS continues, and will be described more thoroughly in a follow-up report later this year.
20. Inconsistencies between commodity code (HS) and commodity text in the ETS export and import data are found, and might indicate imperfect quality. Revision of the data is performed as part of the routine statistics production, based on characteristics of the declarations and experience with the exporting and importing companies. It is therefore assumed that only (minor) parts of the inconsistencies are due to misclassifications.
21. There is an apparent imbalance in the reported refinery statistics of about 350 kt. A more detailed report received from the refinery in question shows that this is mainly due to coke residue burnt off in the calciner and the cracker, flaring and use of self-produced fuel at the plant, which is accounted for in the official energy balance, in addition to a loss of 66 kt. The loss does not either give rise to a statistical difference. However, in the specially reported refinery mass balance 98 kt MTBE is missing on the input side, but not on the output side. This in itself is not a cause of statistical difference, but it makes the quality control by means of the refinery balance a bit weaker. Moreover, the special report, which builds on final figures, states a 20 kt lower conversion of condensate/naphtha (incl. LPG) than the monthly reports forming the micro data in the official and revised energy balances. Together with some other minor differences, this gives an overall imbalance in the refinery data by 115 kt.

Remarks in order to prevent future confusion:

22. NGL from rich gas landed in UK, which is all counted as natural gas in the ETS export, is counted as LPG/NGL in the official energy balance, and the export figures are thus corrected. However, when correcting the natural gas volume, the volume figures in the NPD data for LPG/NGL products can not be used, as they measure the volumes in liquid state. Instead, the mass data are converted to gas volumes using standard densities. The natural gas export in the energy balance is then corrected by using these LPG/NGL gas volume data.
23. Two manufacturing enterprises in the Rafnes area are closely integrated, and as a result one is importing petroleum gases as raw materials and the other is using them. Similar relationships apply to export.

[6] Production for internal use is excluded.

24. Data on stock amounts at one UK terminal are collected on a separate file, and must replace the amounts in the file reported from NPD, which are incomplete.
25. An amount of 13 kt LPG feed stock in one refinery, according to the special report collected in this project, is apparently missing in the official energy balance. However, this LPG is part of the reported condensate/naphtha feed stock according to the ordinary refinery statistics. No correction is needed due to this, as all renaming to LPG already is accounted for in other correction terms.
26. An artifact of the NPD shipment dataset is that LNG given in volume and mass units are placed in different records, which may give the flawed impression that the data set is incomplete with regard to LNG.

7 Transparency and detailed results

Two measures for improving transparency in the energy balance have been considered in this project, including an increased detailing of the energy balance and establishing of transfer posts wherever a product change category. Both were suggested in the previous report. Furthermore, the presence of alternative and detailed micro data increased the transparency in the compilation process. The data sources are described in chapter 4.

In this project a quite detailed setup of the energy balance has been elaborated, which separates both between detailed product types and between primary and secondary products. The setup is even more detailed on products than suggested in the previous report, but must be used with some care. The detailed split was meant as a tool for detecting and isolating big statistical differences, and not as a statistics in itself. Input data are probably not sufficiently detailed for making a perfect split, and this was neither a priority in the project. Hence, some imperfects must be expected. For simplicity, some of the consumption categories are aggregated.

The establishing of transfer posts was not carried out in this project, due to limited time resources, and is suggested as a follow-up task. Instead, the transfers were placed in the conversion post.

7.1 Detailed energy balance setup

7.1.1 Horizontal split

The purpose of the reference approach is to control whether there might be a fossil energy consumption not accounted for in the emission inventory. Hence, a principal idea in this project was to attempt to split the material stream between secondary products, which may be consumed, and primary products, which are mainly converted to secondary products in refineries (at least in Norway).

As the production and export of primary petroleum products by far exceeds the domestic consumption, a presumption in this project was that most statistical differences were due to errors in the primary product data, and not lacks in the consumption data. Thorough quality control and reasona-

ble time series for the consumption data, along with "messy" time series for the statistical difference, supported this (NIR 2013). Hence, if it could be demonstrated, through this horizontally split energy balance, that a vast majority of the statistical difference was due to errors in data prior to the conversion process, the problem with statistical differences, at least as regards greenhouse gas calculations, would be largely solved.

In order to check the consistency between converted primary products and produced secondary products, a mass balance for the refineries was set up.

7.1.2 Vertical split

Most of the categories of liquid and gaseous petroleum products in the official energy balance consist of several product types. Micro data are available for the entire or parts of the balance for all these products, and hence a "vertical" split between the detailed product types could be made. The split was even more detailed than the one suggested in the previous report (NIR 2013). The aim was to detect causes to statistical difference, and in this respect the vertical split proved very useful.

However, as a proper split lacks for several product types for parts of the balance, the vertical detailed split is not perfect. Hence, statistical differences for products within the same product category must be viewed in relation to each other. This applies in particular to primary petrol products, where raw materials at the refineries are classified as condensate, while in the NPD production data they are classified as either NGL or gasoline.

7.2 Detailed results regarding statistical difference in the energy balance

When studying the results, it should be kept in mind that a positive statistical difference means the supply is too high or the use is too low, cf. relations in section 2.3. Supply mainly comes from production, while relatively small amounts are imported. The main uses are export and consumption/conversion. See also conversion factors to other measuring units in section 2.4.

7.2.1 Primary products

Statistical differences according to the final official energy balance and the two alternative ones employing different export data are displayed in Figure AXI- 3. They are displayed with a detailed split on products (detailed product category in parentheses), and only primary products are included in the figure. Tables with the three primary product energy balances are provided in Appendix I, along with a table with detailed secondary products based on the final official energy balance. In order to simplify the text, in this section EB means the detailed energy balance based on the final official energy balance, EB-ETS means the energy balance revised in this project and using ETS as source for export data, while EB-NPD means the energy balance revised in this project and using NPD shipments as source for export data.

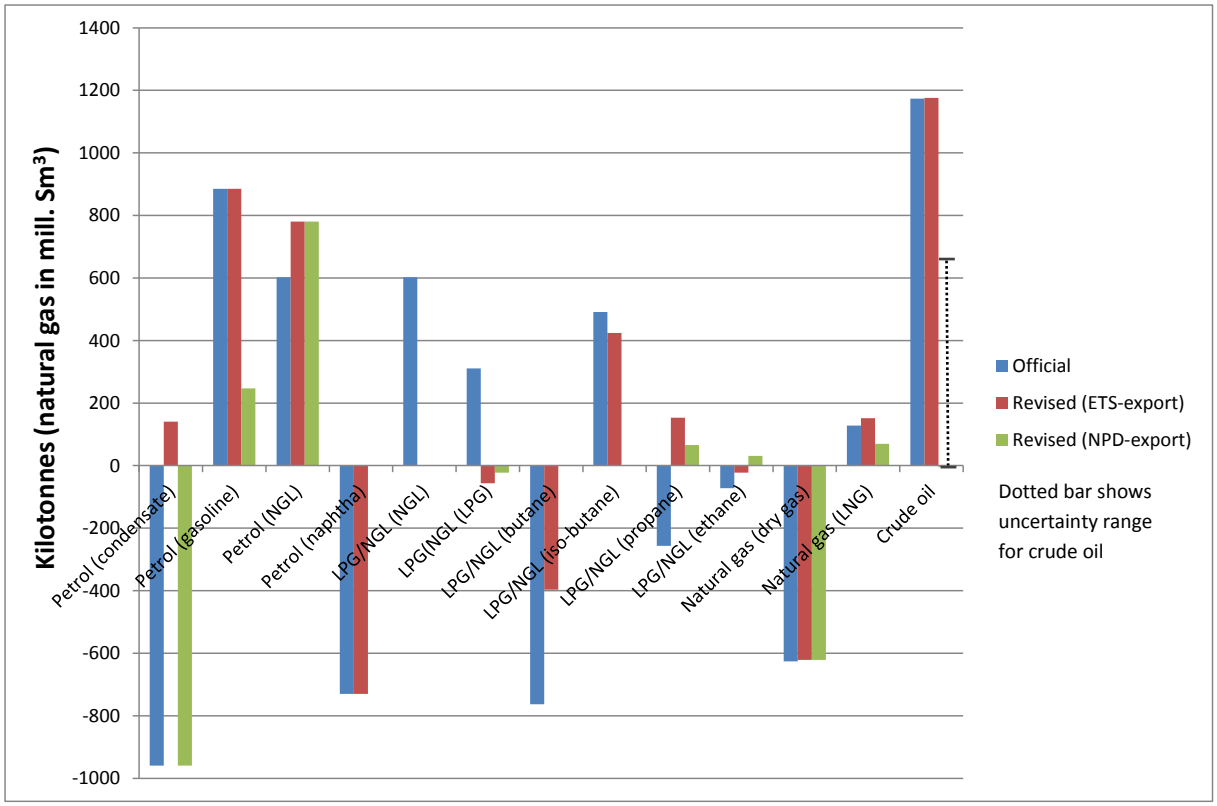

Figure AXI- 3 Statistical differences by detailed primary product categories in 2011. Based on final official and revised energy balances.

Although a bit chaotic, the figure gives quite valuable information about the statistical differences in the original energy balance and the improvements made in this project.

Petrol

Main finding: The EB-NPD approach improved the statistical difference from -202 kt to 68 kt, or 1.2 per cent of the total supply, and provides consistent reasoning. The EB-ETS approach increased the statistical difference to 1 076 kt. All corrections were made in the reference approach.

By splitting petrol into more detailed products, quite huge statistical differences occur. This is due to the existence of several terms for practically the same product, and hence different practices in different data sources, and not strictly an indication of poor quality in the energy balance. However, the inconsistent naming may lead to confusion about the material streams, and may have been a partial reason why the real causes to statistical differences have been so hard to discover.

When bearing in mind the relatively low statistical differences in Figure AXI- 2 for EB and EB-NPD, and the high statistical difference for EB-ETS, Figure AXI- 3 shows some quite interesting features. According to NPD, the export of condensate is almost as large as the production. In EB the ETS export of condensate (HS code 27091000) is replaced with the NDP export of condensate, and this makes the statistical differences for EB and EB-NPD almost similar for this commodity. The negative statistical difference is due to conversion of condensate at the refineries. The condensate could, however, just as well have been called gasoline or naphtha, in coherence with the production data, and thus cancelled out these statistical differences. So far, so good.

However, as summarized in point 3 and 4 in chapter 6, the different naming and classification of petrol products has led to real statistical differences in the petrol product category, with shifts to the LPG/NGL category. To this comes the fractionation of gasoline/NGL in the pre-refinery pretreatment facility described in point 4 (chapter 6), which was missing in the EB input data. The events causing statistical differences for primary petrol in EB and the corrections made in this project are specified in Table AXI- 2.

Table AXI- 2 Features causing statistical differences for primary petrol products in EB, and the effect of corrections in EB-ETS and EB-NPD

Event 1: *Replacing ETS export of condensate (HS 27091000) with NPD export of condensate, without taking into account classification of unrefined condensate products as naphtha (HS 27101191) in the ETS export and the NPD export of gasoline.*			
No.	**Feature in official EB**	**Correction in EB-ETS (kt)**	**Correction in EB-NPD (kt)**
1a	Using NPD export instead of ETS export for condensate	1100	0
1b	Counting the entire ETS export of naphta (i.e. partial double counting)	0	730
1c	Not taking into account the NPD export of gasoline	0	-638
Event 1, subtotal		*1100*	*92*
Event 2: *Applying a fixed split of produced NGL into 50 per cent petrol and 50 per cent NGL/LPG, instead of classifying all as petrol and then including the fractionation of NGL/gasoline into propane, butane and LPG in a pre-refinery pretreatment facility.*			
No.	**Feature in official EB**	**Correction in EB-ETS (kt)**	**Correction in EB-NPD (kt)**
2a	Counting half of produced NGL as petrol, instead of all	602	602
2b	Omitting the fractionation of NGL/gasoline shipments into propane, butane and LPG in one pre-refinery pretreatment facility	-796	-796
2c	Omitting the "renaming" of produced LPG into NGL/gasoline in the NPD shipment data (consequential error)	372	372
Event 2, subtotal		*178*	*178*
Total corrections, primary petrol		*1278*	*270*
Statistical difference, primary petrol (EB = -202 kt)		***1076***	***68***

As can be seen from the table, using ETS as the only data source for the export of (primary) petrol causes a huge statistical difference. This difference is almost eliminated when using NPD shipments as data source and making adequate corrections. The approach in EB hits far better than in the EB-ETS, though the available data have been insufficient for a perfect correction and the reasoning behind seems incomplete. Using the EB-NPD approach gives the best accuracy, providing a statistical difference for primary petrol of 68 kt, or about 1 per cent of the total supply.

The pre-refinery pretreatment and renaming of NGL/gasoline (event 2) was the main cause to statistical differences for primary petrol in EB, while the partial double counting of exported naphtha (1b) and the omission of exported gasoline (1c) nearly balanced. It is unknown to the project whether these events are correlated, i.e. that all production classified as gasoline is exported with commodity code HS 27101191, or the balance between them was accidental.

LPG/NGL

Main finding: The EB-NPD approach improved the statistical difference from 312 kt to 75 kt, or 1.0 per cent of the total supply. The EB-ETS approach improved the statistical difference to 102 kt. All corrections were made in the reference approach.

As for primary petrol, there is confusion about names in the data sources. This is partly because the gases are sometimes found in mixtures and sometimes in an isolated form. There also seems to be a mix-up between butane and iso-butane in the ETS export, as nearly all iso-butane (HS 29011000) is classified as butane (HS 27111300). This itself does not cause statistical differences, but bring confusion to the detailed picture.

The reasons to statistical differences for LPG/NGL at a total level were, as for primary petrol (but with opposite sign), the pre-refinery pretreatment and renaming of NGL/gasoline, in addition to slightly different export figures in the NPD data and some other minor events. The NPD export must be corrected, however, as an amount of produced gasoline/LPG with destination country Norway in the shipment dataset is fractionated at a pre-refinery pretreatment facility and subsequently exported to a foreign country. The events and the corresponding corrections are summarized in Table AXI- 3:

Table AXI- 3 Features causing statistical differences for primary LPG/NGL products in EB, and the effect of corrections in EB-ETS and EB-NPD

Event 1: *Using ETS export data instead of NPD export for all LPG/NGL products.*			
No.	**Feature in official EB**	**Correction in EB-ETS (kt)**	**Correction in EB-NPD (kt)**
1a	Using ETS export for LPG	0	34
1b	Using ETS export for butane	0	773
1c	Missing the correction for shipments of butane with destination country Norway but with a foreign destination (consecutive error)	0	-380
1d	Using ETS export for iso-butane	0	-423
1e	Using ETS export for propane	0	322

1f	Missing the correction for shipments of propane with destination country Norway but with a foreign destination (consecutive error)	0	-416
1g	Using ETS export for ethane	0	53[1]
1f	Three minor fields lacking in the correction of rich gas and unstabilized crude oil landed in UK	-10	0
Event 1, subtotal		-10	*-37*

After correction for event 3a

Event 2: *Applying a fixed split of produced NGL into 50 per cent petrol and 50 per cent NGL/LPG, instead of classifying all as petrol and then including the fractionation of NGL/gasoline to propane, butane and LPG in a pre-refinery pretreatment facility.*

No.	Feature in official EB	Correction in EB-ETS (kt)	Correction in EB-NPD (kt)
2a	Counting half of produced NGL as LPG/NGL, instead of nothing	-602	-602
2b	Omitting the fractionation of NGL/gasoline shipments into propane	416	416
2c	Omitting the fractionation of NGL/gasoline shipments into butane	379	379
2d	Omitting the renaming of produced LPG into NGL/gasoline in the NPD shipment data (consequential error)	-372	-372
Event 2, subtotal		*-178*	*-178*

Event 3: *Other minor corrections.*

No.	Feature in official EB	Correction in EB-ETS (kt)	Correction in EB-NPD (kt)
3a	Wrong measuring unit in the correction of LNG from the export of LPG/NGL (ethane)	-15	-15
3b	Different figures on raw materials	5	5
3c	Different stock figures	-10	-10
Event 3, subtotal		*-20*	*-20*
Total corrections, primary LPG/NGL		*-209*	*-236*
Statistical difference, primary LPG/NGL (EB = 312 kt)		***102***	***75***

Table AXI- 3 shows that the pre-refinery pretreatment and renaming of NGL/gasoline was the major cause to overall statistical difference in EB also for LPG/NGL. As can be seen from Table AXI- 2 and Table AXI- 3 combined (event 2 in both), this pretreatment and renaming resulted in a shift in statistical difference of 178 kt from petrol to LPG/NGL, which was corrected in the two revised EBs.

The use of NPD export led to a minor overall improvement of the statistical difference of 37 kt. Moreover, the improvement of shifts between the detailed product types, especially for butane vs. iso-butane, was substantial and helped clarifying the general picture. This improvement, however, depended on the inclusion of 796 kt butane and propane in the NPD export, in order to obtain completeness. This amount was recorded as gasoline in the shipment data (but partially as LPG in the production data, cf. description of renaming above) with Norway as destination country, went through a fractionation process and was subsequently exported.

The inclusion of three minor fields in the correction step for unstabilized oil and rich gas being brought to shore in UK led to a slight (10 kt) improvement of the statistical difference in EB-ETS. Some other minor corrections were done as well. Event 3a was the most important one, with -15 kt. This event applies when using ETS export figures only (i.e. it cancels out in event 1g and 3a for EB-NPD in Table AXI- 3). It is described in point 6 in chapter 6. The corrections of event 3c and 3d are somewhat uncertain, but were not checked further due to time shortage. These small corrections do not affect the overall picture.

Both revised energy balances gave an improved overall statistical difference, with EB -NPD being the slightly better one. At the most detailed level the EB-NPD was superior. The overall statistical difference for primary LPG/NGL according to EB-NPD is 75 kt, or 1 per cent of the total supply.

Natural gas

Main finding: The EB-NPD approach improved the statistical difference for LNG from 128 MSm^3 to 69 MSm^3, or 1.6 per cent of the total supply. The EB-ETS approach increased the statistical difference to 152 MSm^3. The corrections were made in the reference approach. Only minor corrections of 5 MSm^3 were made for dry gas.

In the detailed EBs natural gas was split into dry gas and LNG, and both natural gas and LNG was measured in MSm^3 according to their gaseous state. The split must be regarded somewhat imperfect, as all conversion and consumption was put on dry gas without further investigation. The only correction made was the conversion of 57 MSm^3 natural gas into LNG at specialized LNG plants. This conversion covers the exported part only, in order to balance the exported LNG, whereas any domestic consumption of LNG is put on dry gas, and hence the conversion of this LNG from dry gas was unnecessary as regards the statistical difference. The converted LNG was put on secondary production. It was also added to the NPD export to obtain consistency, and hence LNG export according to ETS and NPD should be the same.

The vast majority (96 per cent) of this product category is dry gas. However, since the statistical difference was negative (-626 MSm^3) and no NPD shipment data exists, this product was not prioritized. Furthermore, a false trail giving an impression of finding the cause to almost the entire statistical difference (chapter 6, point 10), was unmasked late in the project, leaving no time for further investigation. Only a minor correction of 5 MSm^3 was therefore made on dry gas (section 6.2, point 5).

For LNG, the NPD shipment database contains alternative production and export data, and hence a good basis for quality control existed. Table AXI- 4 shows the corrections made for LNG:

Table AXI- 4 Features causing statistical differences for LNG in EB, and the effect of corrections in EB-ETS and EB-NPD

No.	Feature in official EB	Correction in EB-ETS (*MSm^3*)	Correction in EB-NPD (*MSm^3*)
1a	Using ETS export instead of NPD export	0	3
1b	Missing correction for shipments with destination country reported as Norway but destination specified as Europe (consecutive error)	0	-86
1c	Using 1.36 instead of 1.3524 as conversion factor from kt to MSm3	24	24
Total corrections, LNG		24	-59
Statistical difference, LNG (EB = 128 MSm^3)		***152***	***69***

There seems to be quite good consistence between the ETS and NPD export figures for LNG, when just NPD shipments with destination country other than Norway are included (1a). However, among the shipments with destination country Norway there were several shipments amounting to 86 MSm^3 with destination specified as Europe (1b). These shipments seem to be missing in the ETS export, and a correction was therefore made in the EB-NPD.

Moreover, from the NPD shipments a conversion factor from LNG to dry gas of 1.3524 MSm^3/kt can be derived. As the NPD shipments cover almost 99 per cent of the LNG production, this factor was preferred the EB-ETS as well. This is just a little bit less than the factor of 1.36 being applied in EB, but gives as much as 24 MSm3 rise in statistical difference in both revised EBs. It should be noted that the remaining statistical difference for LNG in EB-NPD is mainly due to inconsistence between NPD production and NPD shipments.

When looking at the statistical difference for natural gas as a whole, the overall statistical difference lays considerably below zero (ranges from -469 to -552 MSm^3 in the three EB versions). At a first glance, this suggests that EB-ETS is the preferred EB version as the high statistical difference for LNG balances the best against the highly negative statistical difference for dry gas. However, as explained above there are clear indications that the statistical difference for LNG should be viewed separately, and not in combination with dry gas. Hence EB-NPD is regarded the superior one for LNG as well, because of the low statistical difference (69 MSm^3), giving an overall statistical difference for natural gas of -552 MSm^3. The statistical difference for dry gas might be considered followed up, by investigating the alternative data at Gassco AS mentioned in section 4.2.

Crude oil

Main finding: The EB-NPD approach improved the statistical difference from 1 173 kt to about -5 kt. However, due to uncertainty in the correction the statistical difference might have been higher, with 660 kt as an upper limit. The EB-ETS approach increased the statistical difference slightly to 1 176 kt. All corrections were made in the reference approach.

Crude oil is not split into more detailed products, and should hence be a bit easier to understand. However, the statistical difference for crude oil in EB is substantial, and previous attempts to correct for this by using NPD shipments as data source for export have failed. During this project, it was discovered that a substantial part of the shipments with destination country Norway seems to have been exported anyway (see below). This regards shipments with different fields (i.e. not a terminal) as origin and one particular terminal/refinery as destination. Table AXI- 5 shows the corrections made in this project and the resulting statistical differences:

Table AXI- 5 Features causing statistical differences for crude oil in EB, and the effect of corrections in EB-ETS and EB-NPD

No.	Feature in official EB	Correction in EB-ETS (kt)	Correction in EB-NPD (*kt*)
1a	Using ETS export instead of NPD export	0	3123
1b	Missing the correction for shipments with destination country Norway but with an assumed foreign destination (consecutive error)	0	-4302[1]
1c	Minor corrections	3	1
Total corrections, crude oil		*3*	*-1178*
Statistical difference, crude oil (EB = 1173 kt)		***1176***	***-5***

1 Contains uncertainty. The right correction might be as "little negative" as -3 637 kt.

There are two reasons why these shipments are assumed to have a foreign final destination: 1) Shipments going to the nearby refinery are recorded with a certain terminal as origin, according to a rule set by NPD. 2) The use of crude oil in the two Norwegian refineries fits reasonably well with the shipments and import of crude oil going to them. There is a difference of -665 kt between supply estimated from NPD shipments surely going to Norway and ETS import, and use according to the refinery statistics[7], which is far from the correction amount of 4 302 kt. Hence most of the crude oil with recorded *origin* from different fields, recorded *destination* to the specific terminal/refinery and recorded *destination country* Norway seems to have been exported, as no other domestic use than in refineries seems possible.

[7] Adjusted for stock changes at the refineries.

The statistic difference in EB-NPD, when assuming that the entire correction amount of 4 302 kt was exported, is -5 kt. This is an almost elimination of the high statistical difference for crude oil. The statistical difference does, however, contain considerable uncertainty, since as much as 665 kt of the correction amount still might have gone to Norway for domestic consumption. The estimated statistical difference in EB-NPD might thus be as high as 660 kt, as a maximum. This is quite high, but still a substantial improvement. The final destination of the shipments comprising the correction amount is currently checked up by NPD, shipment by shipment, and the outcome will be described in the follow-up report.

7.2.2 Secondary products

Main finding: Overall negative statistical differences for liquid products (-498 kt) and positive statistical difference for LPG (169 kt). All findings regard the reference approach. Only one minor correction was made, due to limited time resources.

As no alternative data source has been found for secondary petroleum products, the main approach to detect causes to statistical differences there has been to set up a detailed energy balance and look into the ETS micro data for inconsistencies. However, this work is not completed and no certain conclusions could be drawn. Hence, only one minor correction was made for secondary products in this project. Figure AXI- 4 and Figure AXI- 5 show the statistical differences for main and detailed secondary (or refined) product categories respectively, according to the official (uncorrected) energy balance:

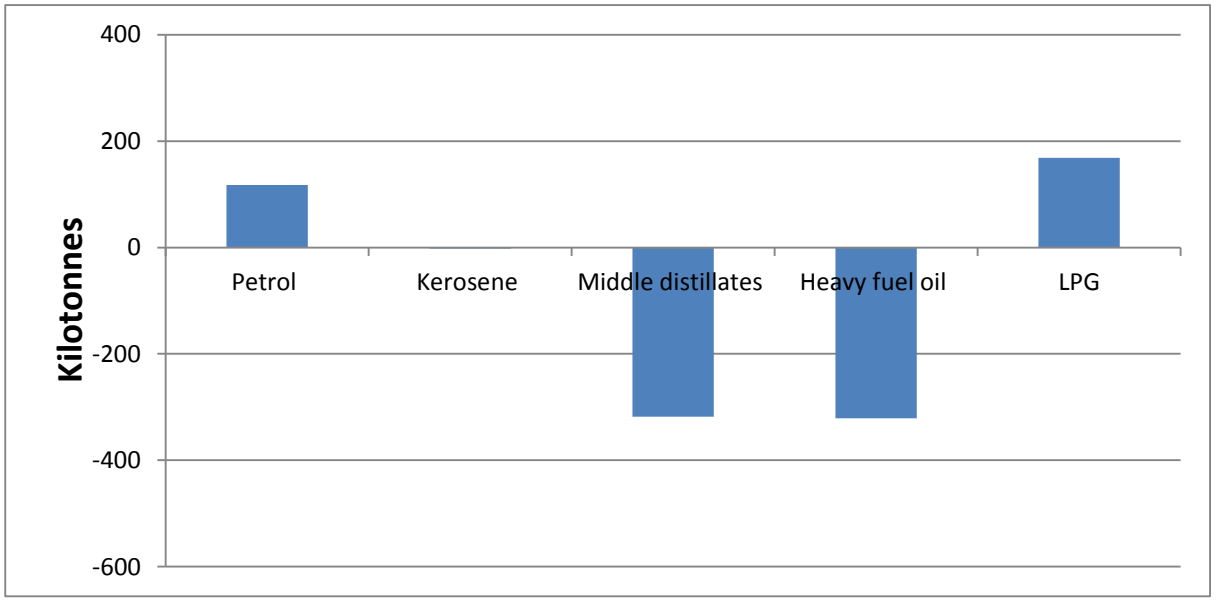

Figure AXI- 4 Statistical differences by main secondary (refined) product categories, 2011.

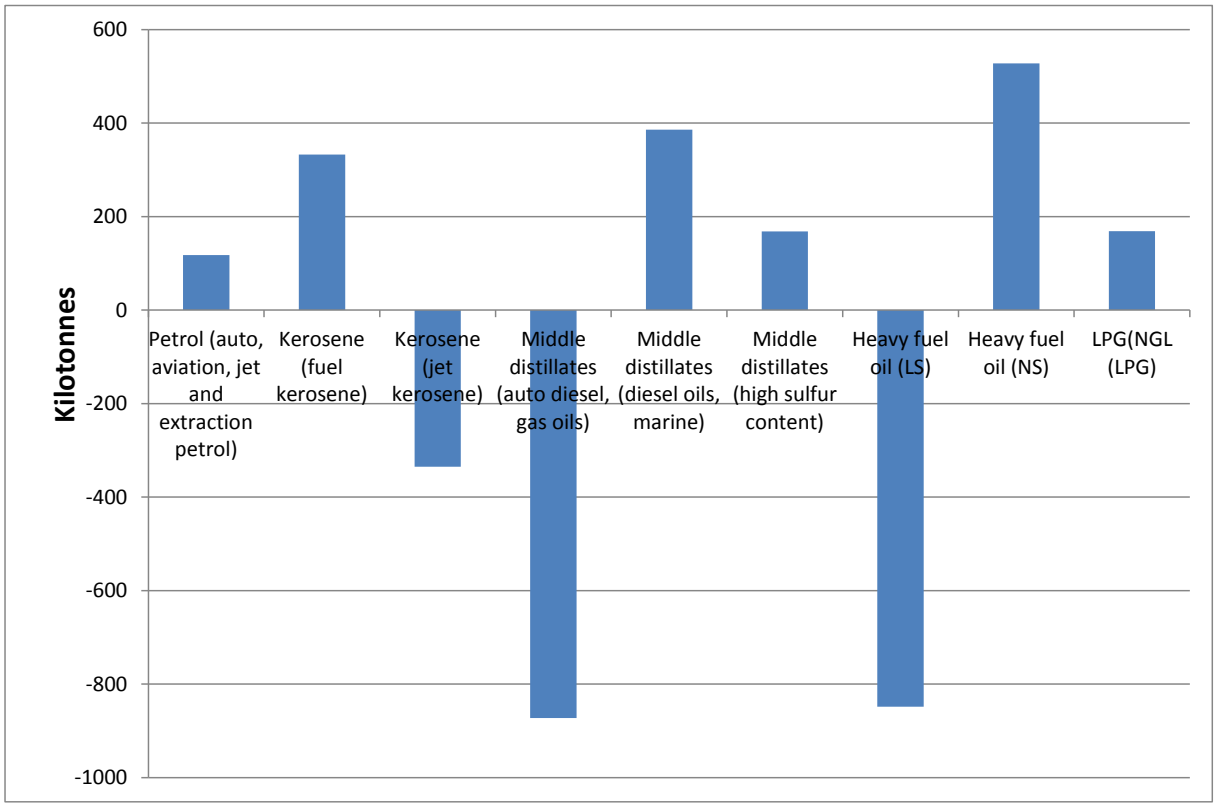

Figure AXI- 5 Statistical differences by detailed secondary (refined) product categories, 2011.

Figure AXI- 5 shows a substantial variation in statistical difference among the different products. This is partly because not all micro data could be split into the most detailed product level, and hence all product of the particular kind was allocated to one product category. As Figure AXI- 4 shows, this variation cancels out to a large extent when applying the main product categories from the official energy balance. At a main product level, three categories are particularly interesting. These are middle distillates, heavy fuel oil and LPG.

For both middle distillates and heavy fuel oil a substantial negative statistical difference appears. This is maybe not so problematic as regards international greenhouse gas commitments, but might indicate overestimation of the greenhouse gas emissions, which is of national concern. EB-ETS shows that for primary petrol, when compared to EB-NPD, a substantial underestimation of the ETS export seems to exist. Hence, an overestimation of the refined “relative” middle distillates in the ETS export might be due to misclassification. A similar solution for crude oil and heavy fuel oil could easily have been suggested, due to the substantial underestimation of the ETS export of crude oil. However, the ETS export of crude oil build on a completely different data source, and the underestimation of crude oil and an eventual overestimation of heavy fuel oil in the ETS export must be viewed independently. Custom declaration of crude oil occurs though, and misclassification of crude oil as heavy fuel oil can not be ruled out as a source of error.

Secondary LPG shows a significantly positive statistical difference, which adds to the slightly positive difference for primary LPG/NGL. Based on ETS micro data it turns out that the unsaturated hydrocarbon propylene is exported from one refinery. Moreover, propylene is sometimes regarded as LPG,

and it is a central raw material in the manufacturing of plastics (Marathon Petroleum, 2012). This is not included in EB! The LPG from this refinery not being exported as propylene, and thus potentially being used as raw material in Norwegian manufacturing, is of comparable size to the statistical difference of secondary LPG. It should thus be considered to check out how much of the LPG from the refinery was propylene being used as raw material in the manufacturing of plastics (or other goods) in Norway.

A minor calculation error in the refinery micro data was found and corrected. This increased the use of jet kerosene as raw material (i.e. conversion) by 26 kt, and hence lowered the statistical difference by the same amount. The revised statistical difference for the two kerosene types combined then becomes -2 kt.

The revised overall statistical difference for secondary products was -329 kt. However, it is unlikely that LPG is mixed up with the other products. When keeping LPG apart, the overall statistical difference sinks to -498 kt. As described above, this might be due to misclassification of condensate and custom declared crude oil as distilled oils. However, it might also result from under-reporting of production from the refineries. Hence, a check of the refinery statistics was performed.

7.2.3 Refinery mass balance and raw material supply

Main finding: An apparent imbalance in the refinery statistics of 350 kt were due to residues and loss not reported in the regular refinery statistics, and not imperfect quality of the refinery statistics. However, a specially obtained report apparently confirming the mass balance seems to be lacking one material stream of 98 kt on the input side, indicating a real imbalance (i.e. imperfect quality). This might explain a positive statistical difference for primary products or negative statistical difference for secondary (refined) products in the energy balance on the 'reference approach side'. No corrections were made.

Mass imbalances in the refinery statistics due to real losses does not give rise to a statistical difference, as the input material to refineries are regarded consumption (i.e. converting) in the energy balance, and the output is regarded new (secondary) production. The losses are thus 'amounts that was never produced', and since they are not used either, no statistical difference occurs.

However, a mass imbalance for the refineries due to poor quality of the refinery statistics would cause statistical differences. The overall negative statistical difference for secondary products might be due to under-reporting of the production of refined products, and the following two possible situations would be an indication of this:

1. Mass imbalance in the refinery statistics, with the production being lower than the use of raw materials.
2. Mass balance in the refinery statistics, with both the use of raw materials and the production being lower than the estimated supply to the refineries.

There is an apparent imbalance in the reported refinery statistics of about 350 kt. A more detailed report received from the refinery in question, in connection with this project, shows that this is due to coke residue burnt off in the calciner and the cracker, flaring and use of self-produced fuel at the plant, which is accounted for in the official energy balance, in addition to a small loss. Not even the loss gives rise to a statistical difference, as the input materials to refineries are regarded consumed

(i.e. converted) in the energy balance, and the output is regarded new (secondary) production. The loss is thus 'amounts that was never produced', and since they are not used either, no statistical difference occurs.

One source of error in the special report seems to be that 98 kt of the additive MTBE is missing on the input side of the mass balance, but not on the output side. Furthermore, the special report seems to be more updated than the monthly reports forming the micro data in the official and revised energy balances, and hence contain a 20 kt downward adjustment of the consumption of condensate/naphtha (incl. LPG). Together with some other minor revisions, and when adding both refineries together, this gives an imbalance of 115 kt, indicating 115 kt too low production figures or 115 kt too high consumption figures. This may explain a correspondingly negative statistical difference for secondary products, or a correspondingly positive statistical difference for primary products.

7.2.4 Estimated additional stocks or time lags – new revision control

Main finding: The NPD production and shipment data on crude oil are consistent during 2008-2012, except for second half-year 2010 and first half-year 2011. Second half-year 2010 the shipments exceed the production by 2 000 kt, while first half-year 2011 the production exceeds the shipments by 414 kt. This might explain an eventually positive statistical difference in the energy balance on the 'reference approach side', but no corrections were made.

According to NPD, the NPD shipments are consistent with the production data, when taking regard of stock changes. Based on this information, a new method was developed to estimate the difference between NPD production and shipments of crude oil, adjusted by reported stock changes[8]. The method applied production and stock figures by month, and shipment figures summed by month. The starting point for the time series was set to December 2007, which means that for this point in time the difference between NPD production and shipments was set to 0. The whole period 2008-2012 was analyzed, and is shown in Figure AXI- 6 and Figure AXI- 7:

[8] Norwegian shares only

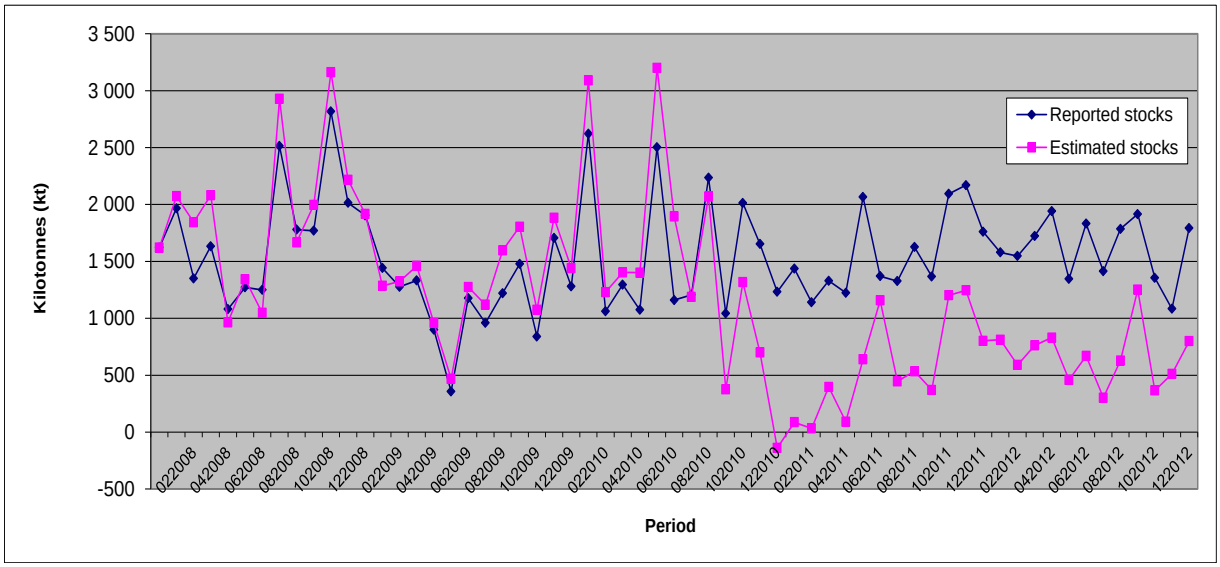

Figure AXI- 6 Estimated stocks vs. reported stocks, 2008-2012.

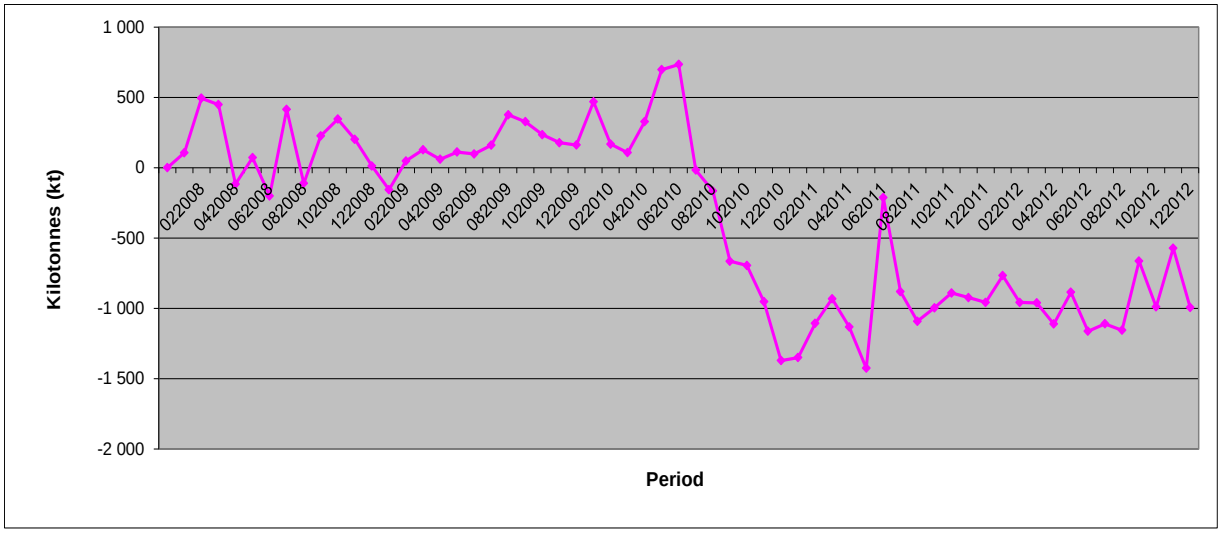

Figure AXI- 7 Difference between estimated stocks and reported stocks, 2008-2012.

Figure AXI- 6 shows that, except for two particular periods, reported stocks and stocks estimated on the basis of NPD production and shipments are highly consistent. The overall picture is that when reported stocks increase, the estimated ones increase as well, and vice versa. The estimated stocks tend to fluctuate somewhat more than the reported ones, which may be due to for instance time lags on the shipments, and this may cause random statistical differences in the energy balance, but no bias.

The two periods showing deviating time series are second half-year 2010 and the first half-year of 2011. Second half-year 2010 the estimated stocks fell about 2 000 kt more than the reported ones (Figure AXI- 7), and at one time below zero. NPD have been contacted about this discrepancy, but no explanation has been found. It will thus be followed up, and eventual findings will be described in the

follow-up report. First half-year of 2011 the discrepancy from the previous half-year was partly reversed.

The interpretation of this, in terms of statistical differences, is that the underestimation of estimated stocks in second half-year of 2010 indicates an underestimation of production or an overestimation of shipments (which include export). This, in turn, is typical causes for negative statistical differences for, in this case, crude oil. As the situation turns around in 2011, this overall revision control points towards a positive statistical difference for crude oil in 2011. When using December as reference month for calculation yearly stock change, in line with the energy balance, a positive statistical difference by 414 kt for crude oil in 2011might be explained by this revision control.

7.3 Use of conversion factors in the reference approach

This section discusses effects of the choice of energy conversion factors (net calorific values = NCVs) and carbon content factors on statistical differences and RA/SA differences. These factors have no effect on the statistical differences in mass terms, but they affect the differences in energy and carbon terms.

The conclusion is that the conversion factors are very unlikely to be the cause of the major differences observed in the energy balance and in the RA/SA analysis. However, the deviations between RA/SA differences in energy and carbon terms might be due in part to the choice of factors.

The most important factors are the ones for crude oil and natural gas. These fuels are both more variable and appear in larger amounts than the other main fuels.

7.3.1 Crude oil carbon content

Although the Reference Approach uses factors for "TJ/kt" (NCV) and "t C/TJ" (C_{TJ}), other factors are also relevant. In particular, the carbon mass fraction (C_{mass}) is relevant. These factors are closely related, and in fact the carbon mass fraction is the product of the other two: $C_{mass} = NCV \cdot C_{TJ}/1000$. The following table shows the IPCC default factors (2006-GL) and the factors used in the Norwegian reference approach:

Table AXI- 6 Conversion factors used in the reference approach

Conversion factor (TJ/Unit)	*Carbon emission factor (t C/TJ)*	*Carbon content (per cent)*	*CO_2 emission factor t CO2/t*
42.3	20.33	86.0	3.153
42.3	20	84.6	3.102

Carbon contents for a large number of crude oil qualities are given in the IPCC Good Practice Guidance (IPCC 2000, table 2.2). The 86 per cent value used in the Norwegian RA is in the very upper

range of values. The Norwegian crude qualities in the table range from 85.1 per cent (Ekofisk) to 85.6 per cent (Gullfaks).

Based on these data, it is very unlikely that the true carbon content is more than 1 per cent below the current value of 86.0 per cent. A decrease of 1 per cent in the factor generally leads to a reduction of about 2 per cent CO_2 emissions from liquid fuels in the RA, since the apparent consumption of crude oil is approximately twice the total apparent consumption of liquid fuels. (Refinery throughput is around twice the domestic consumption of refined fuels.)

However, the relevant carbon content for the reference approach is not the average for the total crude oil production, but the average for the crude oil consumption at Norwegian refineries. The following table shows an analysis of refinery data as reported to the IEA for 2011:

Table AXI- 7 Balance for refineries in mass, energy and carbon terms. 2011.

	Refinery intake	*Refinery Gross Output*	*Difference*	*Difference, per cent*
kt	15 927	15 818	-109	-0.7 %
PJ[1]	672	681	9	1.3 %
kt carbon[2]	13 687	13 626	-61	-0.4 %

[1]) PJ values converted from tonnes using NCV values reported to the IEA (which differ slightly from the ones used in the energy balance for some fuels).

[2]) Carbon content calculated with standard emission factors from the Norwegian emission inventory.

The table was calculated from data on intake and output by fuel and then aggregated.

The table shows that in this case, the balance in carbon terms is less negative than in mass terms, indicating that the conversion makes the intake too low. If the carbon content in the crude oil intake were increased to 86.3 per cent, the balance would the same in mass and carbon terms.

Thus, the oil field data and the refinery data point in different directions with respect to the carbon content. The oil field data indicates a slightly lower value, while the refinery data indicates a slightly higher value. Both sources indicate that large errors arising from this factor is unlikely. There is currently not enough information to suggest another value.

The refinery table also shows that the intake in PJ terms seem to be much more underestimated than the intake in carbon terms, relative to the primary mass balance. This may indicate that the NCV used for crude oil is too low. If the NCV were increased to 43.25 TJ/kt, the balance would be the same in mass and in carbon terms.

7.3.2 Crude oil NCV and t C/TJ

During this project, no information was found on how NCV and C_{TJ} varies with carbon mass fraction. Therefore, no conclusions can be drawn on NCV for crude oil. One can only note that for a given carbon mass fraction, the carbon content by TJ is inversely related to the NCV. This means that for a given carbon mass fraction, several combinations of NCV and t C_{TJ} are possible.

These factors have not been explored in detail in this project, but should be subject to further work.

7.3.3 Natural gas

For gaseous fuels, there is no problem with supply and consumption measured in different fuels. However, natural gas is very heterogeneous across the different parts of the energy balance. In particular, most of the gas consumption is at the offshore oil and gas fields, where the composition of the gas is different from the dry gas which is exported. The effects of NCV and carbon content are explored in Tables AXI-5—AXI-7 in annex XI, and in the notes to these tables.

7.4 New quality control in the sectoral approach

7.4.1 Alternative data on energy use in the manufacturing sector

In 2013, Statistics Norway conducted a project where it was examined if energy data collected by the Norwegian Environment Agency (Norwegian Climate and Pollution Agency at that time) could be used for quality control when editing data on energy use in manufacturing (NIR 2013). The datasets were shown to be comparable. Some minor differences were found, but the overall consistency and coherence were good.

Energy data from the Norwegian Environment Agency is therefore still used when editing the data on energy use in manufacturing. The data on the biggest units are cross checked. Small differences are allowed, but the data are used directly if values are missing or very inconsistent.

Only very minor effects on the statistical difference are expected, and only for products for which data on petroleum sale do not make up the total consumption (i.e. coal, coke, natural gas and LPG).

8 Related works

8.1 General

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 accounts as well as the energy accounts and national accounts. Work on consolidating the energy accounts and the national accounts is part of regular work with statistics. Focus-areas within this work are annually defined. In 2013 and 2014, focus is among other on transport (air transport and ocean transport).

8.2 Statistics on deliveries of petroleum products

Statistics on deliveries of petroleum products is one of the most important data sources for the energy balance and the sectoral approach. A pilot project to improve quality of the statistics was carried out in 2011 (Isaksen et al. 2012). The result was promising and led to changes in the methodologies for the annual petroleum statistics.

Previously, annual figures were based on adding up monthly figures for deliveries of petroleum products. The sources of data on monthly deliveries are the oil companies that operate in the Norwegian market, as well as import and export figures from the external trade statistics (ETS). The data received from the oil companies contain figures on monthly sales of petroleum products, distributed by oil company, product, 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. However, there are uncertainties regarding the quality of the data received from the oil companies, especially the allocation to purchaser groups.

Based on results from the pilot project, Statistics Norway started collecting annual information from the four largest oil companies. In addition to the information that is collected monthly, the companies are instructed to send detailed information for every delivery, including the customers' organisation number. Data from ETS are also given with organisation numbers. In the Norwegian Business register, the organisation number is provided with a code for Standard Industrial Classification (SIC2007). Thus, connecting the customer records with the Norwegian Business register produces detailed information about what kind of business activity the buyers of the petroleum products are involved in. Some deliveries lack organisation number and therefore cannot be connected to the SIC codes in the Norwegian Business register; others are given SIC codes that does not represent the end-use of the petroleum products. In these cases, the purchaser groups provided by the oil companies and information given by the name of the costumer are used to attain the distribution of the deliveries to SIC codes.

The statistics on annual deliveries of petroleum products are aggregated into 22 industrial groups. More detailed information on the industrial distribution can be provided if required for the energy balance. The new annual statistics were published for the first time on the 31th of March this year, covering the years 2009-2013 (Statistics Norway 2014b), and will be implemented in the energy balance for the whole time series in autumn 2014, using 2009-2011 as junction years. Although the industrial distribution of the annual deliveries of petroleum products differ for the distribution over purchaser group in the annual statistics, only small differences are observed when comparing the total annual and monthly volumes. The annual figures for the different reference years are between 1 per cent lower and 1 per cent higher than the sum of the monthly figures.

Thus, minor random statistical differences might have occurred from inaccuracies in the petroleum delivery statistics, but it is not a likely explanation for the biases.

8.3 New IT platform for the energy balance

A project for developing a new IT platform for the energy balance, which was in the planning phase at the time of the previous reporting, was formally started up in November 2013. The energy balance

is 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. The new project will aim at restructuring the production system for the energy balance into a data warehouse solution. 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.

In the current phase of the project, focus is on structuring the input data. The goal is to obtain a common structure of all input data so that they can be complied in a database, and to replace manual processing of the data by an automated one. This will ensure consistency and reduce the risk of error. Work on designing the data warehouse solution will commence in August 2014. According to the current plan, the new production system for the energy balance will be implemented in November 2015.

9 Conclusions and recommendations

9.1 Conclusions

Several causes to statistical differences in the energy balance were found in this project, and all apply to the supply side of the energy balance, which corresponds to the reference approach in the greenhouse gas inventory. The search for lacks and inconsistencies in the energy balance has been broad, and the consumption side of the energy balance, which corresponds to the sectoral approach, has been extensively checked as well. However, all findings on the consumption side confirm the official energy balance. This supports the previous Norwegian position that the causes to the vast majority of the statistical differences are to be found within the reference approach. Due to data availability, the reference year investigated in this project was 2011.

The overall sum of statistical differences in the 2011 energy balance was reduced from 429 ktoe to

-743 ktoe, or -0.3 per cent of the total supply, when using NPD as data source for export data and making adequate corrections. This does not immediately look like an improvement. However, when dissecting the results, primary products apart from dry gas show a probable reduction in statistical difference from 1 410 ktoe to 207 ktoe, or 0.2 per cent of the corresponding supply, which is a substantial advance. Due to uncertainty in the correction of crude oil, this revised statistical difference might be as high as 872 ktoe. Even this is a substantial advance. When using ETS export for all these products, the statistical difference increased to 2 505 ktoe, even after all other corrections were made. The remaining products, i.e. dry gas and refined products, showed an overall negative statistical difference by about -980 ktoe. However, as no alternative data source was available only two minor correction was made for these products.

As much as 4 302 kt crude oil, 796 kt LPG/NGL and 86 MSm^3 LNG must be added to the NPD export, in order to obtain completeness. These are shipments recorded with Norway as destination country, but with characteristics and/or alternative data showing that the final destination is, or probably is, in a foreign country. As mentioned above, the correction of crude oil contains uncertainty.

As suggested in the previous report (NIR 2013), substantial statistical differences in the official energy balance were due to undercoverage and/or misclassification in the ETS export, at least for 2011. Moreover, the substitution of ETS export of condensate with NPD export of condensate in the official energy balance, which makes a substantial improvement of the statistical difference for this product, is to a large extent justified. However, inconsistencies in other data were found to cause statistical differences in the official energy balance as well. The most important ones were the fractionation of petrol into LPG/NGL at one pre-refinery pretreatment plant, which was established in 1999, and the inconsistent naming of petrol products in different data sources.

The findings in this project have been possible due to the collection of new data and a detailed setup of the energy balance developed in this project. The new data comprise the NPD shipment data containing an additional variable (destination), a mass balance from one refinery, and detailed export data from one refinery pretreatment facility. Moreover, extensive use of ETS micro data has been made, in order to compare ETS and NPD shipments, identify the exporting enterprise and get information on the geographical location of the export site. The detailed energy balance setup comprise a 'vertical' split of the main product categories in the official energy balance into several more specific products, as well as a 'horizontal' split between primary and secondary products. Two mass balances for refineries, i.e. for the input and for the conversion, were also set up, in order to identify possible 'leakages' of errors between the primary and secondary products.

Crude oil:

The main reduction of statistical difference is made for crude oil, from 1 173 kt to -5 kt. This rests on an assumption that shipments recorded with certain characteristics in NPDs shipment database, i.e. certain fields as origin, a certain terminal/refinery as destination and Norway as destination country, are in fact going to a foreign destination in the next step. This assumption leads to the correction of the NPD export of crude oil by 4 302 kt.

The correction is somewhat uncertain. As shown by analyzing the data on raw materials used in the refineries, as much as 665 kt of the corrected amount might have had Norway as final destination country anyway. However, an overall revision control of the NPD shipment data against production and stocks shows a potential overestimation of the production or underestimation of the shipments (of which export comprises the vast majority) of 414 kt, and the conversion mass balance for the refineries indicates a possible overestimation of the conversion of crude oil by 115 kt (see 'other findings' below). These 529 kt counters the 665 kt mentioned above. Early signs from NPD indicate that it is not straight forward to get exact data on final destination for the shipments forming basis for the correction of crude oil. In sum, this means that the statistical difference for crude oil might be as high as 660 kt or 0.8 per cent of the total production as a maximum, but that it is probably lower. The statistical difference of -5 kt used in figures and tables is an operational, easy-to-make, estimate positioned in the lower end of the uncertainty range. A follow-up work will be done in order to further dissect this uncertainty.

Primary petrol:

The official approach in EB, using NPD shipments for export of condensate and ETS for other petrol products, gave a statistical difference for primary petrol products of -202 kt, or -4 per cent of the total production. This is fairly close to zero, when regarding the level of detail, though the reasoning

behind the correction seems incomplete. By using the EB-NPD approach (i.e. with NPD shipments as data source for the export of all relevant products) and making adequate corrections, this difference was brought even closer to zero. Furthermore, this approach has a consistent reasoning. The statistical difference for primary petrol by the EB-NPD approach was 68 kt, or slightly more than 1 per cent of the total production. Using ETS as the only data source for the export of primary petrol gave a huge statistical difference for primary petrol products of 1 076 kt, even after all other adequate corrections were made.

The pre-refinery pretreatment and renaming of NGL/gasoline into different LPG products was the main cause to statistical differences for primary petrol in EB, and its correction caused a shift in statistical difference of 178 kt from LPG/NGL to petrol. A significant double counting of 730 kt exported naphtha in the ETS export and the omission of 638 kt exported gasoline according to the NPD shipments nearly balanced, though a difference of 92 kt remains, and it is unknown whether these two events were correlated or the balance between them was accidental.

The establishing of the pretreatment facility in 1999 seems to be the starting point for these inconsistencies.

LPG/NGL:

The pre-refinery pretreatment and renaming of NGL/gasoline into different LPG products was the major cause to overall statistical difference in EB also for LPG/NGL. By correcting for this, the statistical difference was reduced by 178 kt in the two revised EBs.

The use of NPD export led to a further minor overall improvement of the statistical difference by 37 kt for LPG/NGL in the EB-NPD. Moreover, the improvement of shifts between the detailed product types, especially for butane vs. iso-butane, was substantial and helped clarifying the general picture. A slight (10 kt) improvement of the statistical difference in EB-ETS was achieved by including three additional minor fields in the correction step for unstabilized oil and rich gas being brought to shore in UK led to. Some other minor corrections were done as well. However, these are not relevant when using NPD as data source for export figures.

Both revised energy balances gave an improved overall statistical difference, with EB -NPD being the slightly better one. The overall statistical difference for primary LPG/NGL according to EB-NPD was 75 kt, or 1 per cent of the total supply, and 102 kt according to EB-ETS. The official EB gave a statistical difference of primary LPG/NGL by 312 kt. At the most detailed level the EB-NPD was superior, which helped identifying causes to statistical differences.

Natural gas:

The vast majority of the natural gas, 96 per cent, is dry gas. However, since the statistical difference was negative (-626 MSm^3) and no obvious alternative data exists, this product was not prioritized. Furthermore, a false trail giving an impression of finding the cause to almost the entire statistical difference of dry gas was unmasked late in the project, leaving no time for further investigation. No correction was therefore made on dry gas.

For LNG, there is fairly good consistence between EB-ETS and EB-NPD. However, shipments of LNG having destination country Norway contain several shipments with destination specified as Europe. These shipments, amounting to 86 MSm^3 were assumed to have a foreign final destination country in

EB-NPD and were included, but seem to be missing in the ETS export. Moreover, from the NPD shipments a conversion factor from LNG to dry gas of 1.3524 MSm^3/kt can be derived. This is just a little bit less than the factor of 1.36 being applied in EB, but gives as much as 24 MSm3 rise in statistical difference in both revised EBs. Due to these circumstances, the statistical difference of LNG in EB-NPD and EB-ETS end at 69 and 152 MSm^3 respectively. The remaining statistical difference in EB-NPD is mainly due to inconsistence between NPD production and NPD shipments.

Looking at the statistical difference for natural gas as a whole gives overall statistical difference from

-469 to -552 MSm^3 in the three EB versions. At a first glance, this suggests to prefer the EB-ETS for LNG, as the high statistical difference balances the best against the highly negative statistical difference for dry gas. However, there are clear indications that the statistical difference for LNG should be viewed separately. Hence EB-NPD, having the lowest statistical difference, is regarded the better one for LNG as well. This gives an overall statistical difference for natural gas of -552 MSm^3.

Secondary products:

No alternative data source has been found for secondary petroleum products, and the tedious work of identifying causes to statistical differences for secondary products is not finished. However, a correction of one minor calculation error in data from the refinery statistics was made. This increased the use of jet kerosene as raw material in refineries by 26 kt, and resulted in an overall statistical difference for the two kerosene types of -2 kt.

For secondary products except LPG, a substantial negative statistical difference of -498 kt exists. This is maybe not so problematic as regards international greenhouse gas commitments, but might indicate overestimation of the greenhouse gas emissions, which is of national concern. Misclassification and underreporting in the ETS export are natural starting points for further investigation, as using NPD export seems to give consistently improved energy balance for primary products.

Secondary LPG shows a significantly positive statistical difference of 169 kt, which adds to the slightly positive difference for primary LPG/NGL. LPG produced at one refinery seems to contain propylene, which might be used as raw material in Norwegian manufacturing of plastics and hence fall outside the energy balance. The amount might be of comparable size to the statistical difference of secondary LPG, and should thus be checked out. The use of fossil products as raw materials is part of the reference approach, as no emissions are generated.

Other findings:

NPD shipments shall be consistent with the production data, when taking regard of stock changes. A new method was developed to estimate the difference between NPD production and shipments of crude oil (estimated stocks), for comparison with reported stocks. Except for two particular periods, reported stocks and estimated stocks were highly consistent during 2008-2012, but with slightly higher variation in the estimated stocks. However, second half-year 2010 the estimated stocks fall about 2 000 kt more than the reported ones, while first half-year of 2011 this discrepancy was partly reversed. The underestimation of estimated stocks in second half-year of 2010 points toward a corresponding negative statistical difference in the energy balance. In 2011, this estimation points towards a positive statistical difference for crude oil in 2011 by 414 kt.

There is an apparent imbalance in the reported refinery statistics of about 350 kt. A new detailed report shows that this is due to coke residue burnt off in the calciner and the cracker, flaring and use of self-produced fuel at the refineries, in addition to a small loss. Neither of this gives rise to statistical differences. However, 98 kt of the additive MTBE is missing on the input side of the mass balance, but not on the output side. Together with some other minor revisions, this gives an imbalance indicating 115 kt too low production figures or 115 kt too high consumption figures. This may explain a correspondingly negative statistical difference for secondary products, or a correspondingly positive statistical difference for primary products.

The choice of energy conversion factors (NCVs) and carbon content factors on statistical differences and RA/SA differences have no effect on statistical differences in mass terms, and are very unlikely to be the cause of major statistical differences in the energy balance and in the RA/SA analysis even in terms of energy or carbon content. However, the deviations between RA/SA differences in energy and carbon terms might be due in part to the choice of factors.

10 Recommendations and further work

Even though the statistical differences have been considerably reduced in this project, there is need for some further work. The need probably looks different depending on whose perspective is being taken. While positive statistical differences are the most concerning ones regarding Norway's international greenhouse gas commitments, also the negative ones are of concern in a national climate perspective, as well as for the energy statistics and related statistics.

A follow-up report will be published by Statistics Norway in the course of the year, with principally the same content as this report and with updates for some of the further work. It will also provide a broader discussion of how to utilize the findings from this project in the energy statistics.

The list below summarizes tasks that might be considered to be followed up. The list is split into different topics.

Remaining tasks to be completed in the follow-up report:

1. Attempt to improve the crude oil correction of the Norwegian shipments having a foreign final destination, as current micro data are somewhat insufficient for a precise quantification. This improvement should include a follow-up against NPD on the shipment control against production and stocks, and against the refinery in question for the refinery balance. It should also include searching for alternative data on export of crude oil from the terminal in question.
2. Conclude the scrutinizing of ETS export and import. A considerable amount of work has been done in this project, and the follow-up report will describe the work thoroughly and provide the results.
3. Check up the alternative data on natural gas at Gassco AS, and compare with the ETS export if an adequate comparison is possible. Verify that all natural gas power plants and LNG factories are included in NPD production data.
4. Check the use of propylene from one refinery as raw material in Norwegian manufacturing.
5. Check up the inconsistency between NPD production and shipments for LNG.

6. Establish transfer posts in the detailed energy balances, in order to increase transparency.

Tasks to be considered regarding the implementation of findings from this project in the EB:

7. Use NPD export for primary liquid and gaseous petroleum products in EB, instead of ETS export. These corrections require the use of NPD shipment data with destination, which is currently available for the period 2008-2011 only. Special programming is needed for the extraction of these data, and data for the whole time-series will therefore, according to NPD's plans, not be available until 2015.
8. Make corrections of petrol in EB for the following incidents: a) fractionation of NGL/gasoline into LPG products at a pre-refinery pretreatment plant, b) renaming of produced LPG to shipped gasoline, and c) the consistency of exported gasoline in the NPD shipments versus the double counting of exported naphtha in the ETS export. This involves the special collection of data on export from one pre-refinery pretreatment plant.
9. Use correct measuring unit when adjusting for LNG in export of ethane, in case ETS is still the preferred data source.
10. Correct for the three additional minor fields landing unstabilized crude oil and/or rich gas in UK.
11. Calculate yearly conversion factors for LNG to dry gas from the NPD shipment data, as tiny differences in conversion factor give significant changes in statistical difference.
12. Establish transfer posts in the official energy balance.

Tasks to be considered regarding the completion of EB time-series with findings from this project:

13. Make all similar corrections as for 2011 throughout the whole time-series. This involves using NDP shipment data with destination.
14. Update figures on natural gas used for methanol production throughout the whole time-series. At present, only 2011 and a few other recent years are provided with this correction.

Other tasks to be considered:

15. Establish routines to obtain consistent production and export data in EB and related statistics. At the present small differences might occur due to different timing of the production processes.
16. Establishing a routine, in cooperation with NPD, for labelling values in the NPD production data having known deviations.
17. Collect annual refinery data after the end of the year, in order to get the most updated version of the data.
18. Implement, as a revision control in EB, the comparison of Rafnes raw materials and fuel gas against Rafnes shipments. This involves using NPD shipment data with destination.
19. Using payments of CO_2 tax as a check for offshore energy use. This task has not been prioritized within the time frame of this project, as it is not affecting the statistical differences. The reason why the statistical differences are not affected, is that the same amount is applied on

both the production and the consumption side of the energy balance. However, a follow-up might be considered as the use of CO_2 tax data represents a method for verifying a substantial part of the calculated emissions.

Tasks described in chapter 8 Related works are organised in separate projects or part of the ordinary work at Statistics Norway' Division for environmental statistics, and they are therefore not included in the list of tasks above.

Note that the new guidelines from the UN climate convention (UNFCCC) might require changes in how to set up the reference approach. This is not examined in this project, but major changes are not expected.

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Appendix I: Detailed primary and secondary product energy balances

Appendix I shows three tables with the alternative primary (unrefined) product energy balances, along with one table with detailed secondary (refined) products. Some consumption posts are aggregated.

Table I- 1 Detailed energy balance for primary (unrefined) fossil liquid and gaseous energy carriers, 2011. Based on official figures (EB).

	Petrol	Petrol	Petrol	Petrol	LPG/	LPG/	LPG/	LPG/	LPG/	LPG/	Natural	Natural
	Con-densa-	Gaso-line	NGL	Naph-tha	NGL	LPG	Butane	Iso-butane	Propa-ne	Ethane	Dry gas	LNG
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
Primary energy pro-duction	3 352	881	602	0	602	665	1 152	491	2 722	1 101	101 868	4 315
Fractionation and LNG production	0	0	0	0	0	0	0	0	0	0	0	58
Imports	154	0	0	0	0	0	11	66	71	0	0	1
Exports	3 313	0	0	730	0	141	1 944	77	2 721	533	96 060	4 246
Changes in stocks (+ = decrease)	-8	4	0	0	0	0	30	10	-25	0	0	0
Gross domestic supp-ly	185	885	602	-730	602	523	-752	490	47	568	5 808	128
Energy converted	1 144	0	0	0	0	26	0	0	0	0	803	0
Energy industries own use	0	0	0	0	0	3	0	0	0	219	4 631	0
Losses in transporta-tion and distribution	0	0	0	0	0	0	0	0	0	22	15	0
Statistical differences	***-959***	***885***	***602***	***-730***	***602***	***311***	***-763***	***490***	***-256***	***-72***	***-626***	***128***
Final consumption, excl. non-energy use	0	0	0	0	0	56	0	0	0	0	394	0
Non-energy use	0	0	0	0	0	128	11	0	303	399	591	0

	Crude oil
	Crude oil
	kt
Primary energy production	82 526
Fractionation and LNG production	0
Imports	1 140
Exports	68 730
Changes in stocks (+ = decrease)	-450
Gross domestic supply	14 486
Energy converted	13 316
Energy industries own use	0
Losses in transportation and distribution	0
Statistical differences	***1 170***
Final consumption, excl. non-energy use	0
Non-energy use	0

Table I- 2 Detailed energy balance for primary (unrefined) fossil liquid and gaseous energy carriers, 2011. Revised, with NPD export figures (EB-NPD).

	Petrol	**Petrol**	**Petrol**	**Petrol**	**LPG/ NGL**	**LPG/ NGL**	**LPG/ NGL**	**LPG/ NGL**	**LPG/ NGL**	**LPG/ NGL**	**Natural gas**
	Condensate	**Gasoline**	**NGL**	**Naphtha**	**NGL**	**LPG**	**Butane**	**Iso-butane**	**Propane**	**Ethane**	**Dry gas**
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
Primary energy production	3 352	881	1 204	0	0	665	1 152	491	2 967	1 118	101 868
Fractionation and LNG production	0	0	0	0	0	0	380	0	416	255	0
Imports	154	0	0	0	0	0	11	0	71	66	0
Exports	3 313	638	0	0	0	107	1 551	500	3 060	513	96 055
Changes in stocks (+ = decrease)	-8	4	0	0	0	0	19	10	-25	0	0
Gross domestic supply	185	247	1 204	0	0	558	10	1	369	926	5 813
Energy converted	1 144	0	424	0	0	398	0	0	0	0	803
Energy industries own use	0	0	0	0	0	3	0	0	0	451	4 631
Losses in transportation and distribution	0	0	0	0	0	0	0	0	0	45	15
Statistical differences	***-959***	***247***	***780***	***0***	***0***	***-22***	***-1***	***1***	***66***	***31***	***-621***
Final consumption, excl. non-energy use	0	0	0	0	0	56	0	0	0	0	394
Non-energy use	0	0	0	0	0	123	11	0	303	399	591

Natural gas	Crude oil
LNG	Crude oil
kt	kt
4 315	82 269
58	0
1	1 140
4 305	69 648
0	-450
69	13 311
0	13 316
0	0
0	0
69	***-5***
0	0
0	0

Table I- 3 Detailed energy balance for primary (unrefined) fossil liquid and gaseous energy carriers, 2011. Revised, with ETS export figures (EB-ETS).

	Petrol	Petrol	Petrol	Petrol	LPG/ NGL	LPG/ NGL	LPG/ NGL	LPG/ NGL	LPG/ NGL	LPG/ NGL
	Conden-sate	**Gaso-line**	**NGL**	**Naphtha**	**NGL**	**LPG**	**Butane**	**Iso-butane**	**Propane**	**Ethane**
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
Primary energy production	3 352	881	1 204	0	0	665	1 152	491	2 720	1 101
Fractionation and LNG production	0	0	0	0	0	0	380	0	416	255
Imports	154	0	0	0	0	0	11	0	71	66
Exports	2 213	0	0	730	0	141	1 947	77	2 726	550
Changes in stocks (+ = decrease)	-8	4	0	0	0	0	19	10	-25	0
Gross domestic supply	1 284	885	1 204	-730	0	523	-386	424	456	872
Energy converted	1 144	0	424	0	0	398	0	0	0	0
Energy industries own use	0	0	0	0	0	3	0	0	0	451
Losses in transportation and distribution	0	0	0	0	0	0	0	0	0	45
Statistical differences	***141***	***885***	***780***	***-730***	***0***	***-56***	***-396***	***424***	***153***	***-23***
Final consumption, excl. non-energy use	0	0	0	0	0	56	0	0	0	0
Non-energy use	0	0	0	0	0	123	11	0	303	399

Natural gas	Natural gas	Crude oil
Dry gas	**LNG**	**Crude oil**
kt	kt	kt
101 868	4 315	82 533
0	58	0
0	1	1 140
96 055	4 222	68 730
0	0	-450
5 813	152	14 492
803	0	13 316
4 631	0	0
15	0	0
-621	***152***	***1 176***
394	0	0
591	0	0

Table I- 4 Detailed energy balance for secondary (refined) fossil liquid and gaseous energy carriers, 2011.

	Petrol	**Petrol**	**Kerosene**	**Kerosene**	**Middle distillate**	**Middle distillate**	**Middle distillate**
	Naphtha	**Auto, aviation and jet petrol**	**Fuel kerosene**	**Jet kerosene**	**Auto diesel, gas oils**	**Diesel oils (marine)**	**Normal sulphur (NS)**
	kt	kt	kt	kt	kt	kt	kt
Secondary energy production	1 586	3 821	431	415	3 569	2 949	751
Imports	0	205	179	266	1 027	37	147
Exports	1 595	2 832	106	126	1 842	575	577
International marine bunkers	0	0	0	0	0	266	4
International aviation bunkers	0	0	0	372	0	0	0
Changes in stocks (+ = decrease)	9	28	79	-81	-262	4	20
Gross domestic supply	0	1 222	584	102	2 492	2 149	337
Energy converted	0	0	202	26	179	468	18
- in oil refineries	0	0	202	26	176	432	18
- other conversion	0	0	0	0	3	35	0
Energy industries own use	0	0	0	0	8	217	0
- crude petroleum and natural gas production (fuel)	0	0	0	0	0	215	0
- crude petroleum and natural gas production (fla-	0	0	0	0	0	0	0
- other use in industries	0	0	0	0	8	2	0
Losses in transportation and distribution	0	0	0	0	0	0	0
Statistical differences	***0***	***118***	***333***	***-309***	***-873***	***386***	***168***
Final consumption, excl. non-energy use	0	1 105	48	411	3 179	1 078	151
Manufacturing, mining and quarrying	0	0	1	0	238	0	14
- manufacture of industrial chemicals	0	0	0	0	36	0	2
- manufacture of metals	0	0	0	0	14	0	0
- manufacture of paper and paper products	0	0	0	0	3	0	0
- other manufacturing, mining and quarrying	0	0	1	0	185	0	13
Transport	0	1 078	0	379	2 425	643	60
Other sectors	0	27	47	31	515	435	77
Non-energy use	0	0	0	0	0	0	0

Heavy fuel oil	Heavy fuel oil	LPG/ NGL
Low sulp-hur (LS)	Normal sulphur (NS)	LPG mix
kt	kt	kt
1 739	22	430
769	604	90
1 874	0	207
210	0	0
0	0	0
61	0	0
485	625	314
1 195	98	0
1 195	98	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
-871	***528***	***168***
138	0	145
79	0	100
20	0	1
0	0	20
57	0	2
1	0	77
57	0	2
3	0	43
23	0	0

Norwegian Environment Agency
Telephone: +47 73 58 05 00 | Fax: +47 73 58 05 01
E-mail: post@miljodir.no
Web: www.environmentagency.no
Postal address: Postboks 5672 Sluppen, N-7485 Trondheim
Visiting address Trondheim: Brattørkaia 15, 7010 Trondheim
Visiting address Oslo: Strømsveien 96, 0602 Oslo

The main tasks of the Norwegian Environment Agency are the reduction of greenhouse gas emissions, nature management and the prevention of pollution.

We are an agency under the Ministry of Climate and Environment with 700 employees in Trondheim and Oslo. The agency also includes the Norwegian Nature Inspectorate, which has more than sixty local offices

Our primary functions are to monitor the state of the environment, provide environment-related information, exercise regulatory authority, oversee and guide regional and municipal authorities, collaborate with the authorities of relevant government sectors, act as an expert adviser, and assist in international environmental measures.