Emissions and Discharges from the Norwegian Petroleum Industry 2002

OLF is a professional body and employer's association for oil and supplier companies on the Norwegian Continental Shelf.

The oil and gas industry is Norway's most important industry and the country's largest source of revenue. Ours is a high-tech industry which functions as a driving force for other business and industrial development.

Up to now only one-fourth of the expected oil and gas resources on the Norwegian Shelf have been produced. Under the right conditions we will have oil production for at least another 50 years and gas production for at least another 100 years.

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CONTENTS

1 INTRODUCTION

This report presents the emissions to air, discharges to sea and waste generation from Norwegian offshore oil and gas activities in 2002.

The report is prepared for the Norwegian Oil Industry Association (OLF) by Novatech as. The basis for the report is the annual reports on emissions and discharges submitted by each individual operator to the Norwegian authorities.

Aggregated data may deviate slightly from the numbers published by the Norwegian Petroleum Directorate (NPD) and the Norwegian Pollution Control Authorities (SFT, Statens Forurensningstilsyn) for reasons such as differences in scope.

This report contains text and graphic presentations. Data and referenced information are given in Chapter 10, Appendix. This report is also available at www.olf.no.

The report includes the exploration and the production phases of the offshore petroleum activities. Emissions and discharges from 45[1] producing fields and 178[2] exploration and production/injection wells are included. During 2002, 3 new fields started production, and none closed down.

Emissions and discharges during the construction and installation phases are not included. Nor are the emissions and discharges from marine support services and helicopter traffic.

All fields with production facilities located on the Norwegian Continental Shelf (NCS) have been included. This also includes Statfjord and Frigg, which both straddle the median line to the UK sector. Foreign fields, however, with parts of their reservoirs on the Norwegian sector, have not been included (Murchison). By using this geographical split (G), the data differs from data published by the NPD. NPD uses a resource split (R), based on allocation of emissions from fields straddling the median line, in accordance with the Norwegian resource share. The G/R split question is relevant only for production and emissions to air.

Stavanger, June 2003

[1] NPD Annual Report 2002.

[2] According to data extracted from the NPD 2001 and 2002 Annual Reports.

2 THE OIL AND GAS ACTIVITIES IN 2002

2.1 THE PRODUCTION OF OIL, GAS AND WATER

Figure 1 shows the development of the oil/condensate and gas deliveries from the NCS. The oil/condensate deliveries have been relatively stable since 1997, however with a turning trend from year 2000. An increase in gas deliveries started in 1996, and has continued in 2002. The gas deliveries comprised approximately 26 % of the total Norwegian hydrocarbon deliveries in 2002. For comparison, the gas delivery share was 16 % in 1995.

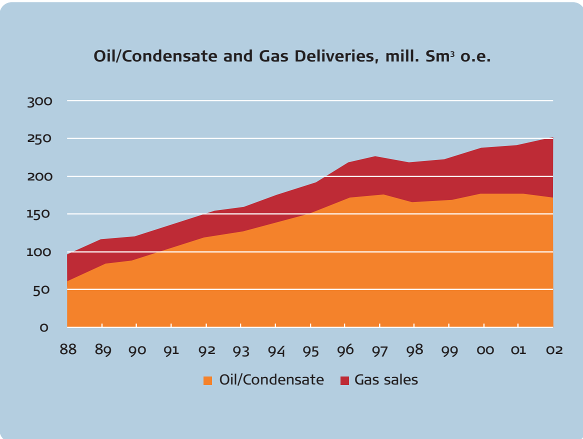

Figure 1 – Historical development of delivered volumes of hydrocarbons (oil/condensate and gas) on the NCS (G).

Figure 2 shows the historical development of water production together with the corresponding oil/condensate production. The graph shows that water constitutes an increasingly larger part of the liquids produced from the wells.

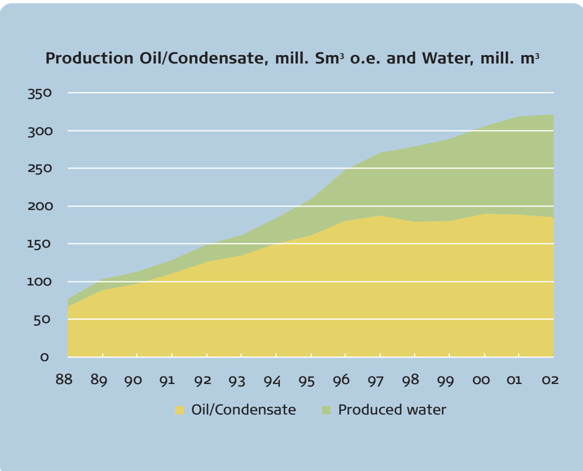

Figure 2 – The historical development of produced oil/condensate and water on the NCS.

In figures, the production in 2002 was 185,2 mill. Sm^3 o.e. (oil equivalents) oil and condensate and 105,5 mill. Sm^3 o.e. gas (65,4 mill. Sm^3 o.e. gas delivered). The balance was injected, flared or used as fuel.

For the oil/condensate production, this is a 2,0 % decrease from 2001, whilst the gas production increased by 12,9 % (+12,0 mill. Sm^3 o.e.) from 2001 to 2002. This increase in gas production resulted in increased gas sales (+12,2 mill. Sm^3 o.e.). In total, approximately 62 % of the produced gas was delivered for sale in 2002 (65,4 mill. Sm^3 o.e.). This means that the gas sales increased by 23,0 % from 2001 to 2002.

The gas injection volumes were 35,9 mill. Sm^3 o.e. in 2002 (increased by 9,4 % from 2001). The seawater injection was 223 mill. m^3 in 2002 (decreased by 5,5 % from 2001).

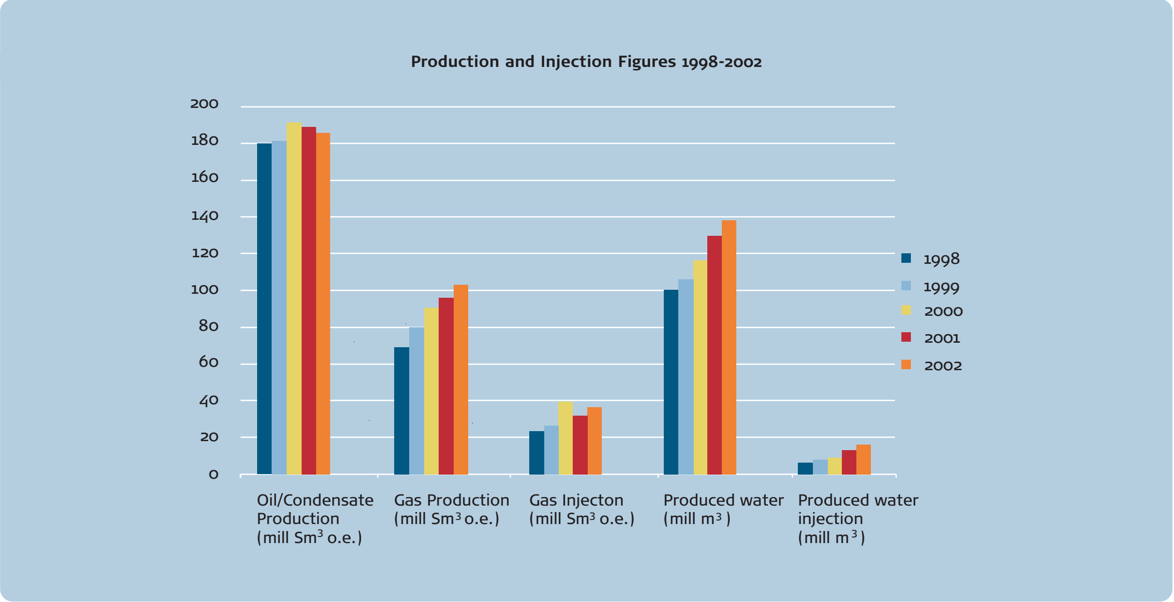

Figure 3 – Key production and injection data for oil and gas 1998-2002 on the NCS.

3 DRILLING AND WELL CLEAN-UP OPERATIONS

Drilling operations create two types of drilling waste:
- Drill cuttings (rock materials)
- Used drilling fluids

There will always be an attachment of used drilling fluids on the drill cuttings.

The industry uses three main types of drilling fluids. Technical and environmental characteristics differ for each type, and the waste disposal requirements given by the authorities vary accordingly:

- **Oil-based drilling fluids (OBM)**
  have relatively low costs, and in most cases better technical properties than the other two drilling fluid types. The authorities do not allow discharges of OBM.

- **Water-based drilling fluids (WBM)**
  are associated with lower costs than oil-based fluids, but the technical properties are in many cases inadequate. The authorities permit discharges of used drilling fluids and cuttings upon application.

- **Synthetic drilling fluids (SBM)**
  are made either on an ester or olefin basis. The technical properties are similar to those of oil-based drilling fluids, but they are expensive compared to the other drilling fluids. Discharges of used SBM are not allowed, but discharges of cuttings may be granted upon application.

26[3] exploration wells and 152[4] production/injection wells were completed in 2002, compared to 29 and 160 in 2001, respectively.

The total generation of mineral oil and synthetic oil based drilling wastes (OBM + SBM drilling fluids and cuttings) was 235 000 tonnes, compared with 212 000 in 2001. This represents an increase of 10,9 %.

3 According to NPD Annual Report 2002.
4 According to data extracted from the NPD 2001 and 2002 Annual Reports.

3.1 DRILLING WITH WATER-BASED DRILLING FLUIDS

Figure 4 shows key figures for drilling with water-based drilling fluids.

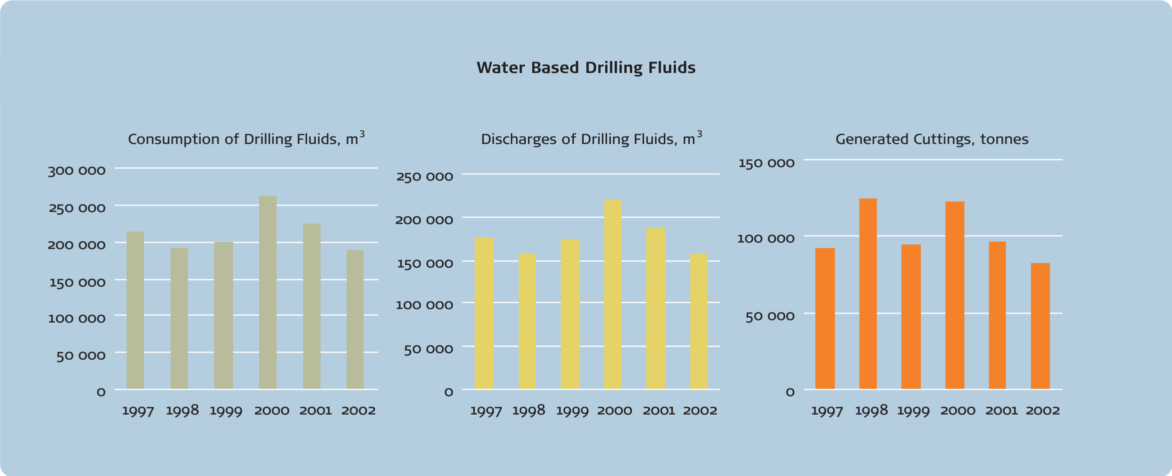

Figure 4 – Cuttings generated, consumption and discharges of water-based drilling fluids for 1997-2002.

188 000 m³ of water-based drilling fluids were consumed in 2002. This is a reduction of 15,8 % from 2001. 10,2 % of the total consumption was related to exploration activities.

Drilling with water based drilling fluid generated 82 000 tonnes of cuttings in 2002, all of which were discharged to sea. In addition, 157 000 m³ of water based drilling fluids were discharged to sea. This is a reduction of 16 % compared to 2001. The discharged amounts of cuttings were decreased by 14 % over the same period.

10,9 % of the total discharges of cuttings, and 9,4 % of the total discharges of water based drilling fluids, was related to exploration activities.

3.2 DRILLING WITH OIL-BASED DRILLING FLUIDS

Figure 5 shows the key figures from drilling with oil based drilling fluids.

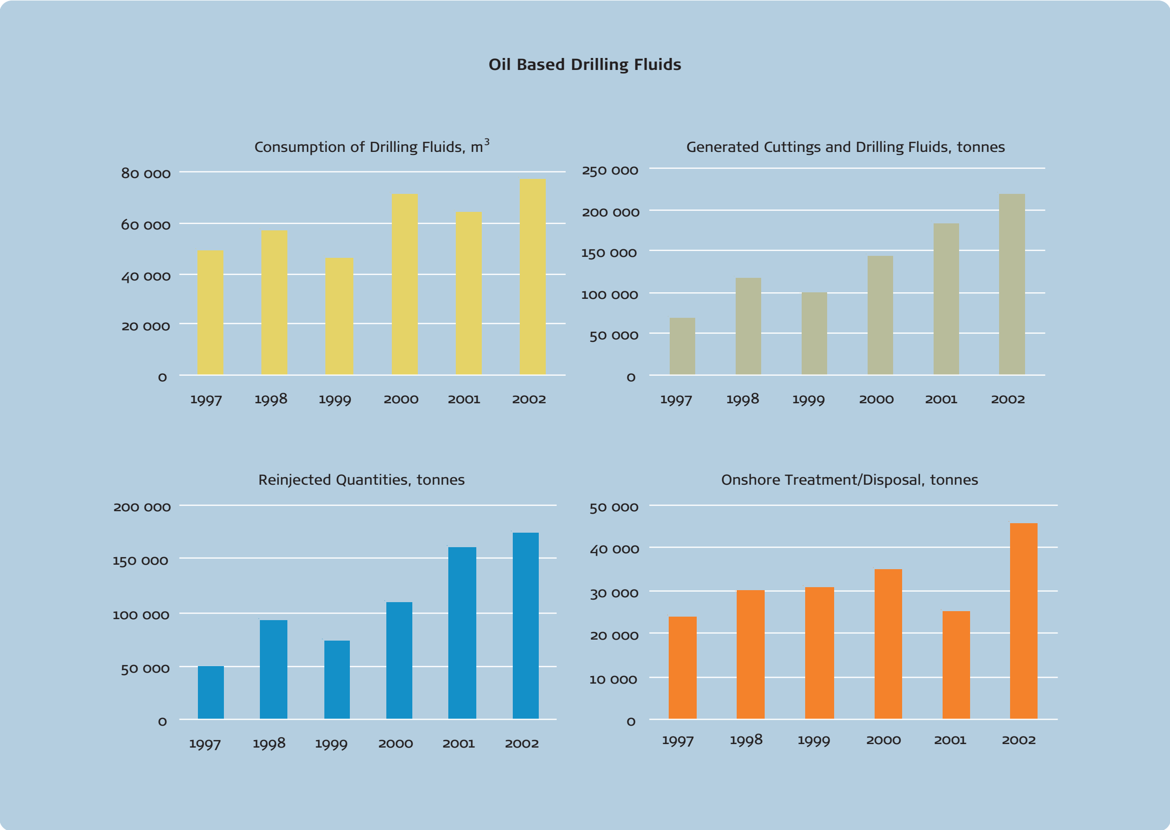

Figure 5 – Key figures from drilling with oil based drilling fluids for the years 1997-2002.

The total consumption of oil-based drilling fluids was 77 000 m^3, of which 5,6 % (4 300 m^3) was related to exploration activities.

The generated quantities of cuttings and drilling fluids using oil-based drilling fluids were reported to 219 000 tonnes in 2002, of which 4,8 % (9 900 tonnes) was related to exploration activities. This is up from 185 000 tonnes in 2001, and represents a 18,1 % increase. Figure 5 shows that injection is the predominant method for disposal of oil-based drilling waste. The injected fraction was 79,8 % in 2002, down from 87,2 % in 2001. Approved onshore facilities dispose off the remaining part. For the exploration activities, most of the waste was disposed off by treatment onshore.

3.3 DRILLING WITH SYNTHETIC DRILLING FLUIDS

The main type of synthetic drilling fluid currently used on the NCS is olefin-based.

Figure 6 shows the key figures from drilling with synthetic drilling fluids.

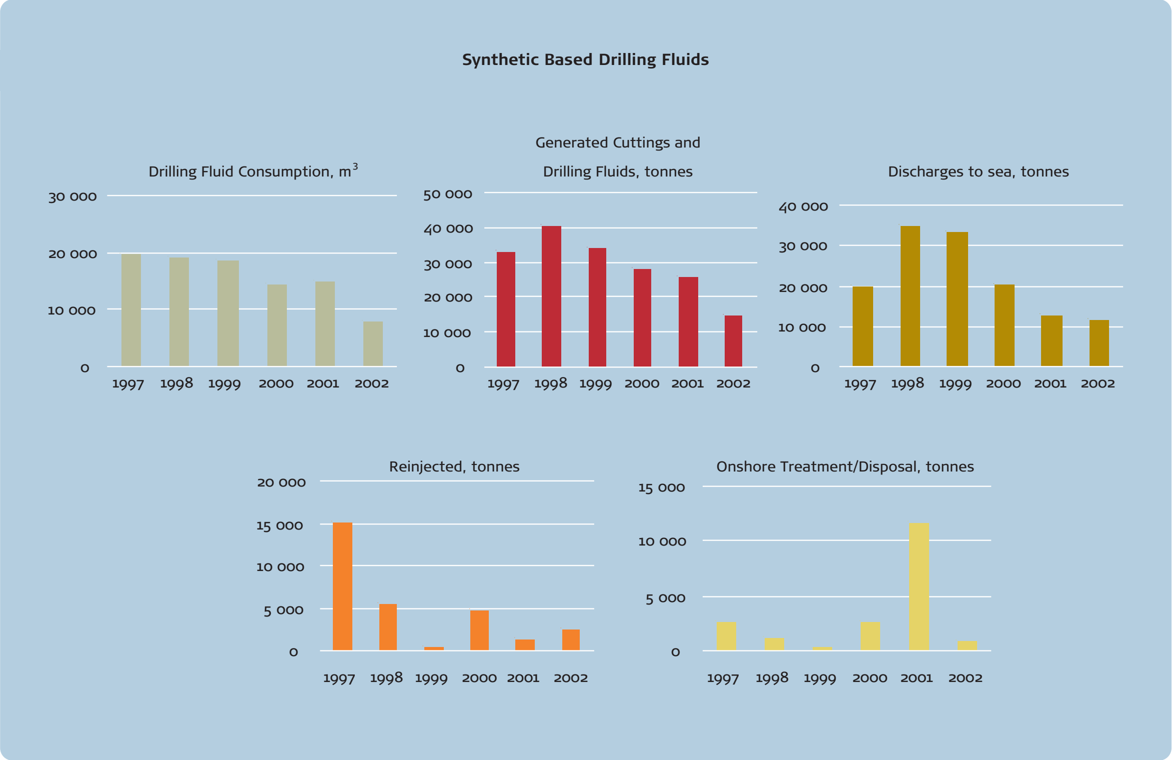

Figure 6 – Disposal of drilling waste from using synthetic fluids for the years 1997-2002.

7 700 m^3 of synthetic drilling fluids were used in 2002, all related to production activities. This represents a 48 % reduction from 2001 (15 000 m^3).

The generated quantities of cuttings and used synthetic drilling fluids were 14 600 tonnes versus 25 600 tonnes in 2001. As illustrated in Figure 6, the predominant method of disposal is discharges to sea.

11 400 tonnes of these wastes were discharged to sea, 2 400 tonnes were injected and 800 tonnes brought onshore for further treatment. This corresponds to a 10 % decrease in total discharged volumes, compared with 2001. The volumes injected and treated onshore vary significantly from year to year depending on the available infrastructure.

4 DISCHARGES TO SEA

The term "zero discharges" was introduced in Storting White Paper No. 58 (1996-1997), and since then the term has been subject to discussions and interpretations.

SFT, NPD and the industry have now agreed on the zero discharge targets for 2005. Reference is made to "Report by the Zero Discharge Group, SFT, OLF and NPD" at www.sft.no/arbeidsomr/vann. This report also contains guidelines for the operators' reporting in the summer of 2003, concerning the status with regard to discharges, work done and additional plans for achieving the zero discharges targets by the end of 2005.

There are three main sources of continuous discharges of oily water from the petroleum activities on the NCS:

- **Produced water**
  is the predominant source of discharges of oil to sea. In addition to dispersed oil, produced water contains different dissolved/dispersed organic and inorganic compounds, including heavy metals.

- **Displacement water**
  originating from the crude oil storage cells on some installations. Discharged volumes are dependent on the volumes of oil produced. This water has a low concentration of dissolved organic and inorganic compounds as well as a low content of dispersed oil.

- **Drainage water**
  includes water from platform decks, etc. Drainage water may also contain chemical residuals. The discharges of drainage water represent a minor amount of the total water volumes discharged to sea.

The maximum oil concentration limit for water discharged from the offshore petroleum industry is 40 mg/l.

Discharges of oil may also come from jet water used for cleaning of process equipment, in connection with accidental situations, and from fall-out of oil droplets from combustion in connection with well testing and well clean-up operations.

4.1 DISCHARGES OF OIL

Figure 7 shows the historical development of all discharges of oil on the NCS:

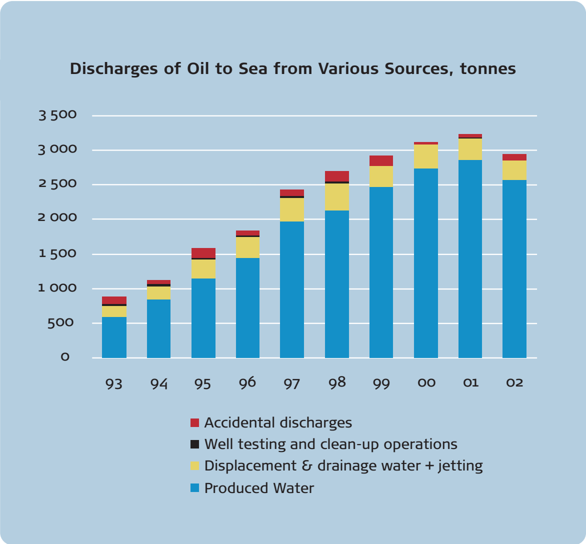

Figure 7 – Historical development of oil discharged to sea from different sources.

In comparison, the development of produced water (produced quantities), is shown in Figure 2.

The total discharges of oil to sea in 2002 were 2 900 tonnes. 96,7 % of this was related to continuous discharges (with produced water, displacement water, drainage water and jetting), and 3,3 % to accidental situations and fall-out from combustion of oil in connection with well testing and well clean-up. Continuous discharges are almost completely connected to the production activities. The discharges from the exploration activities are limited to negligible quantities of drainage water.

4.1.1 PRODUCED WATER

Produced water contributed with 87,3 % of the total discharges of oil to sea from the petroleum industry in 2002 (Figure 7). This is one percentage point lower than in 2001, when the produced water share of the discharges of oil was 88,4 %.

The discharges of produced water however, has increased by 2,5 % over the same period, from 116,1 mill. m^3 in 2001 to 118,9 mill. m^3 in 2002. The average oil concentration in discharged produced water decreased from 24,6 mg/l in 2001 to 21,6 mg/l in 2002 (Figure 9). The reason is reduced oil concentration in produced water from 3 predominant contributors.

The water production in 2002 was 136,3 mill. m^3, which is 4,9 % more than in 2001 (see also Figure 2). 16,6 mill. m^3 produced water was injected, versus 13,2 mill. m^3 in 2001. This constitutes a 26 % increase in the water injection volumes since 2001. The share of produced water injected has increased from 10,1 % in 2001 to 12,2 % in 2002.

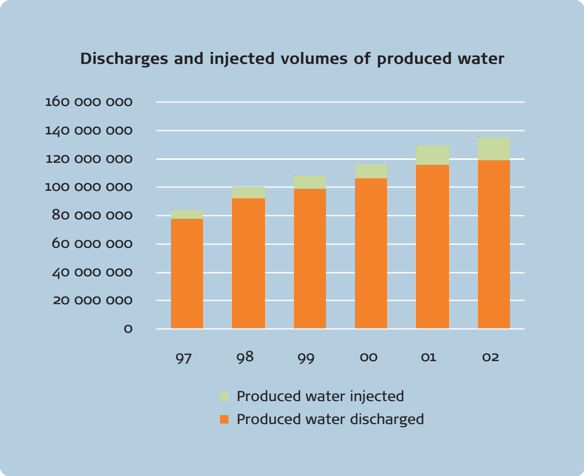

Figure 8 – The volumes of discharged produced water and injected produced water, m³.

Figure 9 shows how the average oil concentration in discharged produced water has fluctuated between 21 and 26 mg/l over the past decade.

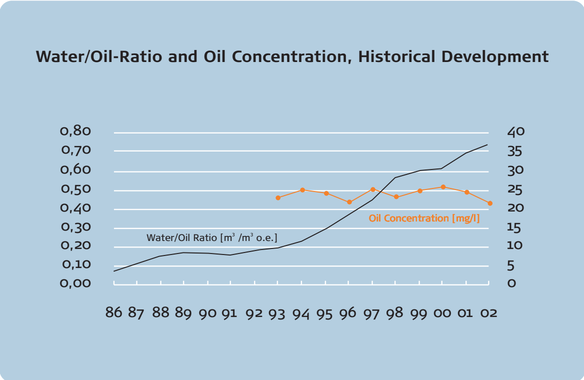

Figure 9 – The historical development of the relation between produced quantities of water and oil (left scale). Right scale: Average oil concentration in produced water discharges 1993-2002.

It also presents the historical development of water produced relative to the oil production. From 1993 onwards, the water production started increasing at a higher rate than the increase in the oil production. This water/oil ratio trend has continued now when the oil production rates are declining. The reason for this development is that several large oil fields on the NCS have reached a mature production phase with continuously increasing water cuts. In 1993 approximately 0,19 m^3 of water was produced for each produced m^3 of oil from the NCS. In 2002 the water/oil ratio was 0,74, and is expected to increase further in coming years.

4.1.2 DISPLACEMENT WATER, DRAINAGE WATER AND JETTING

The discharges of displacement water in 2002 were reduced with 6,1 % from 2001 (60,2 mill. m^3 in 2002 versus 64,1 mill. m^3 the year before). The average oil content in this water was reduced from 4,7 mg/l in 2001 to 4,2 mg/l in 2002. These trends result in a 15,0 % reduction in the total oil quantities discharged to sea with displacement water (255 tonnes in 2002 versus 300 tonnes in 2001).

The discharges of drainage water in 2002 (1,4 mill. m^3) were double from 2001 (0,7 mill. m^3). The oil quantities in discharges of the drainage water increased with 50% (21 tonnes in 2002 compared with 14 tonnes in 2001). One single field constituted for the total increase.

The injected volumes of drainage water increased with 40 % from 33 700 m^3 in 2001 to 47 300 m^3 in 2002.

The reported discharges of oil from sandjetting in 2002 was 0,33 tonnes. This is a substantial reduction from the 4,47 tonnes discharged in 2001.

4.2 HEAVY METALS AND ORGANIC COMPOUNDS IN PRODUCED WATER

The reporting of heavy metals and organic compounds in produced water for 2002 has been more thorough than previous years. Especially the monitoring of organic compounds has been intensified. This means that all historical trends from 2002 onwards will contain more data than previous years.

Discharges of the various heavy metals and organic compounds are calculated based on the concentration in produced water and produced water volumes discharged to sea. All fields on the NCS measure these compounds.

The complete summary of organic compounds discharged in produced water are given in appendix 10.3, Table 12.

4.2.1 HEAVY METALS

In total, the reported discharges of heavy metals with produced water were increased from 12 tonnes in 2001 to over 17 tonnes in 2002. Discharges of zinc, lead, mercury and copper increased. 70 % of the copper discharges were from a single field. Discharges of arsenic, cadmium, chromium and nickel were reduced by more than 50% each.

Figure 10 – Heavy metals discharged with produced water.

The discharges of heavy metals and their relative percentages vary considerably from field to field. The major variations in the metal discharges from one year to the next can be explained by:

- A general change towards the use of field-specific concentration factors during the period.
- The discharges of heavy metals on many fields are close to or below the detection limits.

A small number of fields dominate the discharges of arsenic, copper, nickel and chromium. Compared with the background levels in sea water, the concentrations of heavy metals in produced water are generally low.

4.2.2 ORGANIC COMPOUNDS

The organic compounds in produced water are predominated by carboxylic acids. These are mainly volatile fatty acids such as formic acid and acetic acid. The organic acids accounted for 95 % of the total discharges of these organic compounds in 2002. The remaining components are predominantly BTX (Benzene, Toluene and Xylene), phenols, PAH (Polyaromatic Hydrocarbons) and alkyl phenols. The shares of the total content of dissolved organic compounds are:

- Organic Acids 95 %
- BTX 3,5 %
- Phenols 0,8 %
- PAH compounds 0,15 %
- Alkyl phenols (C1-C3) 0,64 %
- Alkyl phenols (C4-C9) 0,03 %

Figure 11 shows the total discharges of these compounds from 1998-2002.

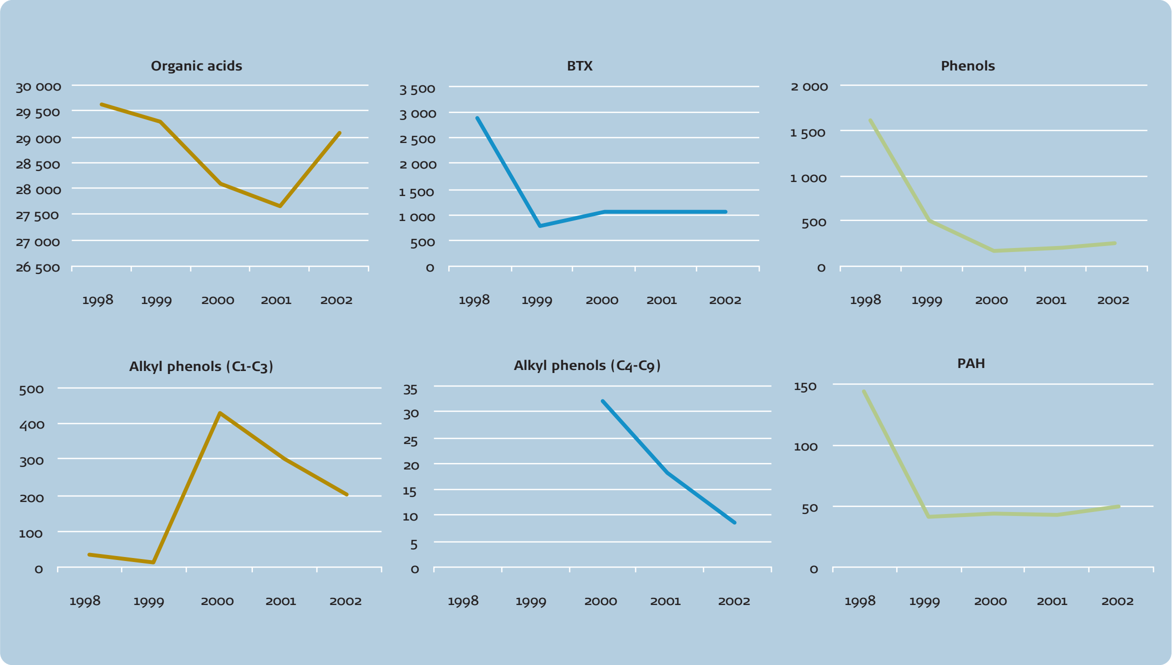

Figure 11 – Discharges of selected groups of hydrocarbons in produced water, tonnes.

The major variations in the content of alkyl phenols in produced water from one year to another may be explained by the use of non-standardised laboratory methodology in previous years. OLF has in 2001 performed a project to develop a standardised methodology for analysing alkyl phenols. Included in the project was a ring-test of the different laboratories. The new standardised methodology was applied for the 2001- reporting onwards.

5 CHEMICALS

5.1 USE AND DISPOSAL OF CHEMICALS

An overview of the development in use, discharges and injection of chemicals is given in Figure 12.

Drilling chemicals, primarily barite and bentonite, represent 88 % of the total use. These chemicals are stated on the PLONOR list; classified as green chemicals (see chapter 5.2).

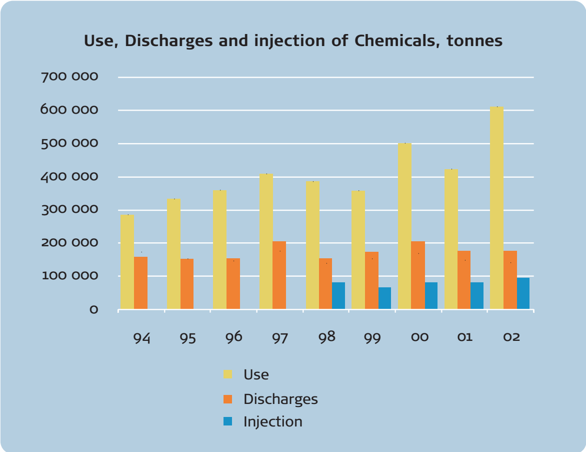

Figure 12 – Use, discharges and injection of chemicals, historical development.

The use of chemicals in 2002 was 604 112 tonnes. This is 169 521 tonnes higher than in 2001, representing an increase of 28,1 %. The predominant reason is the increased use of drilling and well chemicals. One single field has reported and confirmed the use of about 118 000 tonnes of brine (NaCl), corresponding to approximately 70 % of the numerical increases from 2001 to 2002. Without this single-field brine contribution, the use of chemicals in 2002 would have been nearly the same as in 2000.

The discharges of chemicals in 2002 were 176 604 tonnes versus 180 329 tonnes in 2001. This represents a decrease of 2 %. The decrease is mainly due to increased injection of drilling chemicals. The exploration activities' share of the discharges of chemicals was 9,2 % in 2002, versus 9,5 % in 2001.

The total injection of chemicals was 94 940 tonnes in 2002. This represents an increase of 26 % from 2001, when 75 428 tonnes of chemicals were injected.

Historically, the use and discharges of chemicals per delivered unit of oil and gas have been relatively stable, refer Figure 13.

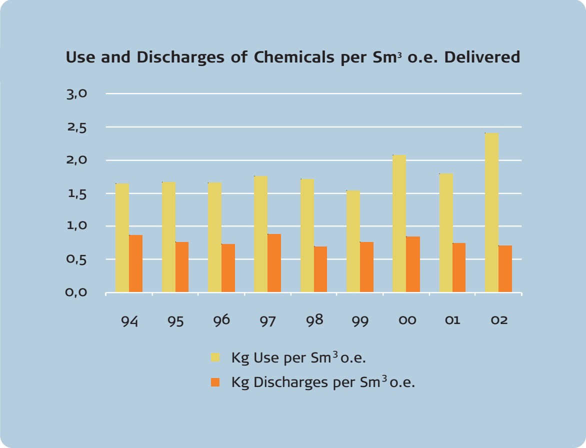

Figure 13 – Use and discharges of chemicals per delivered Sm^3 o.e. oil and gas.

In figures, the specific use of chemicals was 2,4 kg/Sm^3 o.e. oil and gas delivered, and the specific discharges were 0,7 kg/Sm^3 o.e. The relative development from 2001 was +34 % and -5 % respectively.

Figure 14 shows the specific use and discharges for production chemicals only, which give an indication of the efficiency of the predominant drilling chemicals.

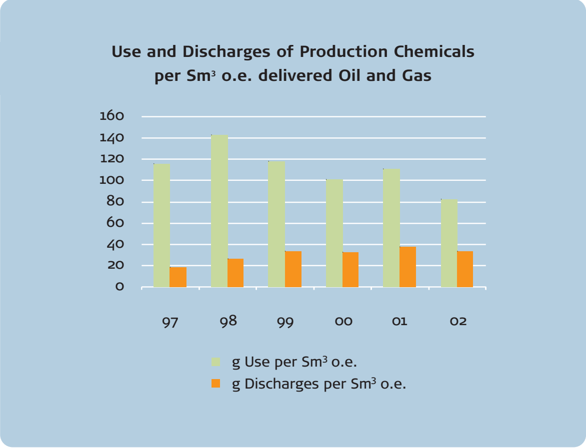

Figure 14 – Use and discharges of production chemicals per Sm^3 o.e. oil and gas.

The specific use of production chemicals has decreased since 1997 with 29 %. The specific discharges have increased with 82 % over the same period. Compared to 2001 however, the specific discharges of these chemicals were slightly reduced in 2002 (from 37 g/Sm^3 o.e. oil and gas delivered in 2001 to 33 g/Sm^3 o.e. in 2002).

5.2 ENVIRONMENTAL EVALUATION OF THE DISCHARGED CHEMICALS

The operating oil companies evaluate the discharges of chemicals according to their environmental properties. The report to SFT contains the results of these evaluations.

Simplified, the evaluations of chemicals are in accordance with the following characteristics:

1. Water and PLONOR compounds (Green chemicals)
   Green chemicals are natural occurring in seawater and/or environmentally acceptable chemicals. No laboratory testing required.
2. Chemicals prohibited for discharges (Black chemicals)
   Use and discharges of black chemicals requires a special permit.
3. Chemicals prioritised for phase-out (Red chemicals)
   Red chemicals are chemicals with high priority to be substituted with better alternatives.
4. Other chemicals (Yellow chemicals)
   Chemicals classified as yellow are laboratory tested and found environmentally acceptable.

	Category[5]	Colour category
Water		Green
Chemicals on PLONOR List		Green
Hormone disturbing chemicals	1	Black
Environmental Toxicant (MiBu-list)	2	Black
BioDeg < 20% and logPow > 5	3	Black
BioDeg < 20% and Tox LC/EC50 < 10 (mg/l, mg/kg)	4	Black
Chemicals on OSPAR Tainting List	5	Red
2 out of 3: BioDeg < 60%, logPow >= 3 or		
Tox LC/EC50 < 10 (mg/l, mg/kg)	6	Red
Inorganic and Tox LC/EC50 < 1 (mg/l, mg/kg)	7	Red
BioDeg < 20%	8	Red
Other Chemicals		Yellow

Table 1 – Classification table for chemical compounds.

Figure 15 shows the historical development of the total discharges of chemicals for each colour category.

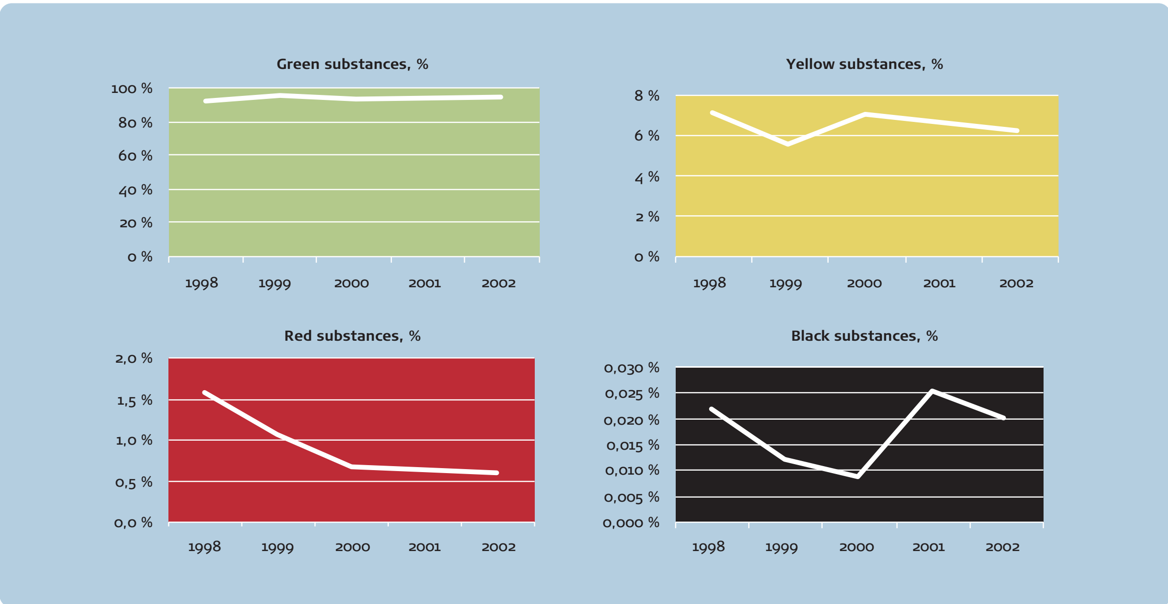

Figure 15 – Total discharges of chemicals for 1998-2002, distributed by environmental categories. Weight percent of chemicals discharged.

5 Category no. set by SFT .

New regulations regarding the reporting practices for chemicals were introduced in 2001. This is the major reason for the increased discharges of chemicals in the black category from 2000 to 2001. The reduction from 2001 to 2002 is mainly caused by a 71 % reduction of chemicals in the category of high bioaccumulation and low degradation properties (log Pow >= 5 and BOD < 20%). The discharges of these chemicals were reduced to 4 tonnes in 2002 versus 25 tonnes in 1998.

Figure 16 shows the 2002 discharges of chemicals, distributed on the environmental groups, including the water content of the chemical products (classified as Green).

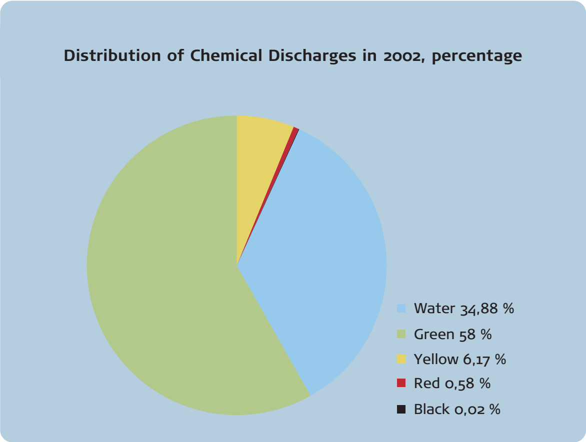

Figure 16 – Distribution of total discharges of chemicals in 2002.

The discharges of chemicals on the MiBu-list, where heavy metals are included, are increased from 0,71 tonnes in 2001 to 0,73 tonnes in 2002. The total discharges of hormone disrupting substances were 1,08 kg in 2002, compared to 704 kg in 1998.

Figure 17 shows the discharges of contaminants and additives in discharged chemicals. Discharges as contaminants are mainly from barite. Pipe dopes are the main contributors to discharges of additives (heavy metals).

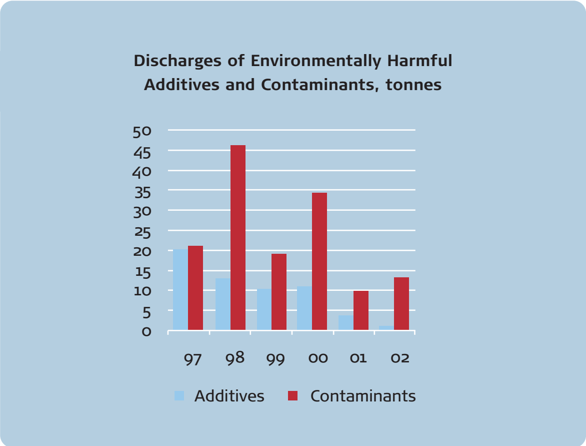

Figure 17 – Discharges of environmental harmful additives and contaminants in chemicals 1997-2002.

6 EMISSIONS TO AIR

The operators report emissions to air based on a geographical split (G) and a resource split (R)[6]. The geographical split is generally used. For fields straddling the Norwegian/UK border (Statfjord and Frigg) and date before 1997, the resource split is used.

6.1 EMISSION SOURCES

The emissions are exhaust gases containing CO_2, NO_x, SO_x, CH_4 and nmVOC from various types of combustion equipment. The main sources are:

- Fuel gas exhaust from gas turbines, engines and boilers.
- Diesel fuel exhaust from engines, gas turbines and boilers.
- Gas flaring.
- Oil and gas burning during well testing and well maintenance work.

Other sources for emissions of hydrocarbon gases (CH_4 and nmVOC) are:

- Gas venting, small leakages and fugitive emissions.
- Evaporation of hydrocarbon gases (mainly nmVOC) from offshore storage and loading of crude oil.

Power generation, using natural gas and diesel oil as fuel, is the predominant reason for the CO_2 and NO_x emissions. These emissions are controlled by energy use and generation efficiency on the installations. The second largest source for these emissions is gas flaring. Gas flaring is required for safety reasons and is permitted during certain operational obstacles.

The predominant source for CH_4 and nmVOC emissions is offshore storage and loading of crude oil. During tank loading, volatile hydrocarbons evaporate to the tank atmosphere and mixes with inert gas required for safety reasons. Emissions occur when this gas mixture ventilates to air as crude oil displaces the mixture in the tanks.

The main cause for SO_x emissions are the combustion of sulphur containing hydrocarbons. Since the Norwegian gas is generally sweet, the consumption of diesel is the predominant source of SO_x emissions on the NCS. The operators on the NCS use low sulphur diesel fuels.

[6] The resource split includes only the emissions that are proportional to the Norwegian part of the oil and gas resources from fields straddling the median line. This also includes emissions from the pumping and booster platforms on the Norpipe pipelines (located outside the NCS). Due to changes in reporting practices, all historical data prior to 1997 are given as resource split, while later data are given as geographical split.

6.2 BURNT QUANTITIES

6.2.1 FLARE, FUEL AND DIESEL CONSUMPTION

Figure 18 shows the historical fuel gas and diesel consumption and flare gas volumes.

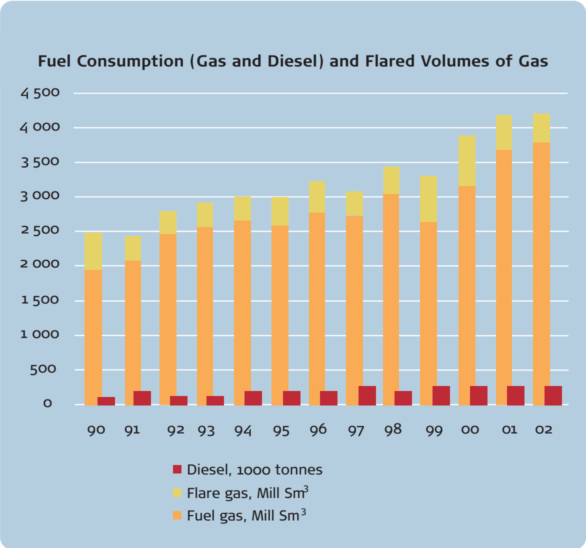

Figure 18 – Fuel gas and diesel consumption, and flared gas volumes. Historical development. Well testing and well clean-up not included.

The fuel gas consumption has gradually increased throughout the last decade (56 % increase since 1992). The main reasons are increased gas compression (gas export and gasinjection) and water injection, which are the predominant power consuming operations in offshore oil and gas production.

The main development trends are:

- The fuel gas consumption has increased by 3 % from 2001 to 2002, mainly due to increased gas export from the Norwegian Sea. Increasing transportation distances require additional compression power.
- In the period from 1992 to 2002, the fuel gas consumption increased with 56 %. Increased gas and water injection, and increased oil and gas deliveries are central contributors to this development, since the correlation between these parameters and the total energy demand is strong.
- Gas flaring has increased by 46 % in the period from 1992 to 2002. This is due to the increased activity level and start-up of new fields.
- From 2001 to 2002 however, the flared volumes of gas decreased by 20 %. The flared volumes of gas have decreased mainly due to reduced flaring on some fields that started up in 1999, 2000 and 2001 which experienced very high flaring rates the first year(s).
- The consumption of diesel fuels has increased by 80 % since 1992. More frequent use of mobile installations account for most of this increase. These units operate solely on diesel fuels. In addition, permanent production units show increased diesel oil consumption.
- From 2001 to 2002, the diesel consumption decreased by 7 %, reflecting a reduced use of mobile facilities.

6.2.2 WELL TESTING AND WELL CLEAN-UP OPERATIONS

12 792 tonnes of oil, 31 mill. Sm³ gas and 366 tonnes of diesel were burned during well testing and well clean-up operations in 2002. The corresponding figures for 2001 were 32 142 tonnes of oil, 26 mill. Sm³ gas and 325 tonnes of diesel. No oil has been recovered during well testing since 1999. A total of 31 tests/well operation jobs were performed in 2002 versus 57 in 2001.

6.3 EMISSION DATA ON AN AGGREGATED LEVEL

History has shown that the differences between the resource split and the geographical split are small. The resource split is only used on data pre 1997 (ref. footnote 6).

The emissions to air are dominated by production related activities, refer Figure 19.

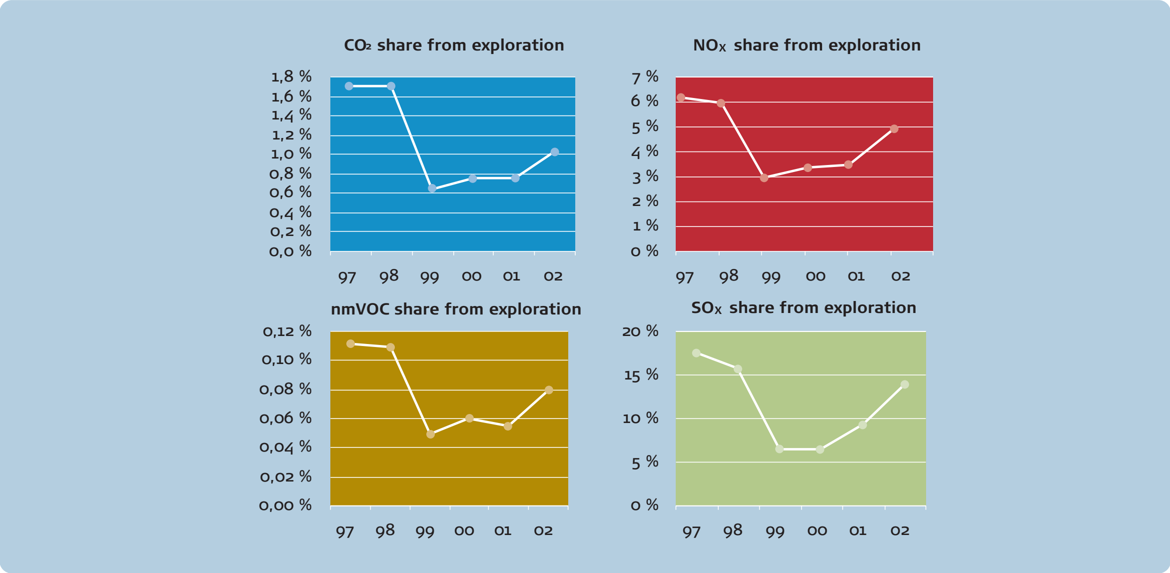

Figure 19 – Exploration related share of total emissions from the NCS in percent for 1997-2002.

However, Figure 19 also shows that the exploration activities are responsible for a much higher relative share of the SOx and NOx emissions than for the CO_2 and nmVOC emissions. The reason for this is that the exploration activities are based on diesel engines as the main energy source. The specific SOx emissions are much higher for diesel combustion than they are for gas combustion, due to the higher sulphur content in diesel fuel than in the gas fuel. Diesel engines also have much higher specific NOx emissions than the gas turbines dominating the power supply on permanent production facilities. The CH_4 emissions from exploration are negligible.

6.4 GREENHOUSE GAS EMISSIONS

Greenhouse gases (GHG) comprise CO_2, CH_4, N_2O, PFK gases, SF6 and HFK gases. The oil and gas activities on the NCS contribute with CO_2, CH_4 and negligible, unregistered quantities of N_2O. In addition nmVOC and CH_4 contribute with indirect discharges.

The greenhouse gas registration is according to their Global Warming Potential (GWP). The GWP monitoring is in CO_2 equivalents. The total GHG effect is the sum of CO_2 equivalents for all emitted GHGs.

The GHG emissions for the offshore sector consist of:

- Direct CO_2 emissions from combustion processes.
- Indirect CO_2 emissions resulting from emission of CH_4 and NMVOC. These gases oxidize in the atmosphere to CO_2. A factor 3,00 for NMVOC and 2,75 for CH_4 are applied according to SFT standards.
- Emissions of CH_4 in GWP. CH_4 has a GWP of 21 in CO_2 equivalents in a horizon of 100 years.

Table 2 presents the GHG emissions based on reported emissions from chapter 6.5, 6.7 and 6.8.

GHG		Emission (mill. tonnes)	GWP	Resulting emission in CO_2 equivalents (mill. tonnes)
CO_2		11.235	1	11.235
Indirect CO_2 emission (process)	CH_4	0.034	2.75	0.093
	nmVOC	0.222	3	0.665
CH_4		0.034	21	0.708
Sum				12.702

Table 2 – GHG emissions in CO2 equivalents from the oil and gas activities on the NCS.

The total GHG emissions from the NCS for 2002 were 12,7 mill. tonnes CO_2 equivalents. This is 1,8 % less than in 2001, when the GHG emissions were 12,9 mill. tonnes CO_2 equivalents.

6.5 CO_2 EMISSIONS

Figure 20 shows the CO_2 emissions development and the 2002 distribution according to emission source.

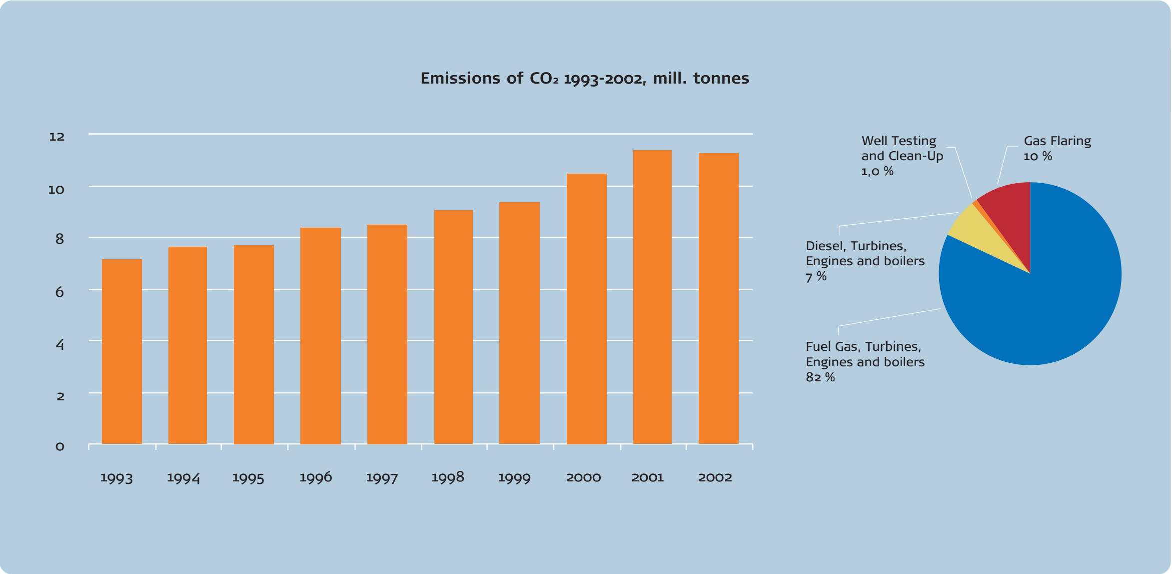

Figure 20 - Historical development of the total CO_2 emissions, mill. tonnes and distribution by source.

The total CO_2 emissions in 2002 was 11,24 mill. tonnes. By this, the CO_2 emissions decreased by 0,13 mill. tonnes (1,2 %) from 2001 to 2002. The reasons are:

- Reduced emissions from flare.
- Reduced emissions from the use of diesel on mobile units.
- Slightly increased emissions from fuel gas consumption.

Figure 20 illustrates that there has been a constant increase in the CO_2 emissions over the last decade. Approximately 84 % of the increases since 1993 are due to higher emissions from the combustion of gas in gas turbines and engines. Increased gas flaring contributes with approximately 8 %, and higher diesel consumption in turbines and engines contributes with 8 % of the increase.

The 2002 emissions are distributed on the various emission sources, as shown by the pie chart in Figure 20. The major changes from 2001 are an increased share from fuel gas (80 % to 82 %), and a reduced share from flaring (12 % to 10 %).

Figure 21 shows the historical development of the specific CO_2 emissions, measured in kg CO_2 per volumes of hydrocarbons delivered.

The specific CO_2 emissions decreased from 1993 to 1997, and then again from 2001 to 2002. A main reason for the improvement is more optimal usage of power generating equipment.

The annual Norwegian emissions of CO_2 in 2002 were approximately 40,3 mill. tonnes[7]. Thus, the share contributed by the oil and gas industry in 2002 was approximately 28 % (27% in 2001).

[7] Preliminary 2002 data from Statistics Norway.

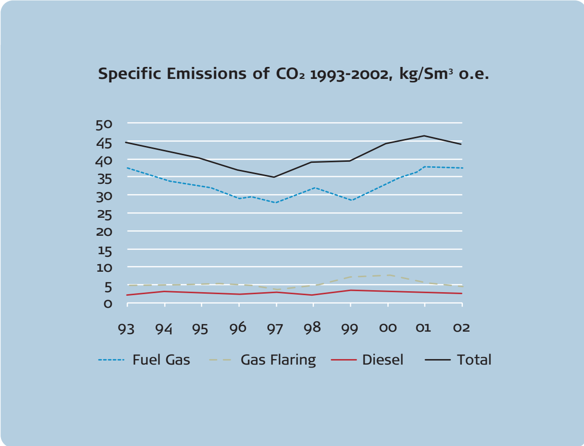

Figure 21 – Specific emissions of CO2 1993–2002, distributed by sources.

6.6 NOx EMISSIONS

Figure 22 shows the historical development of the NOx emissions and the 2002 distribution according to emission source.

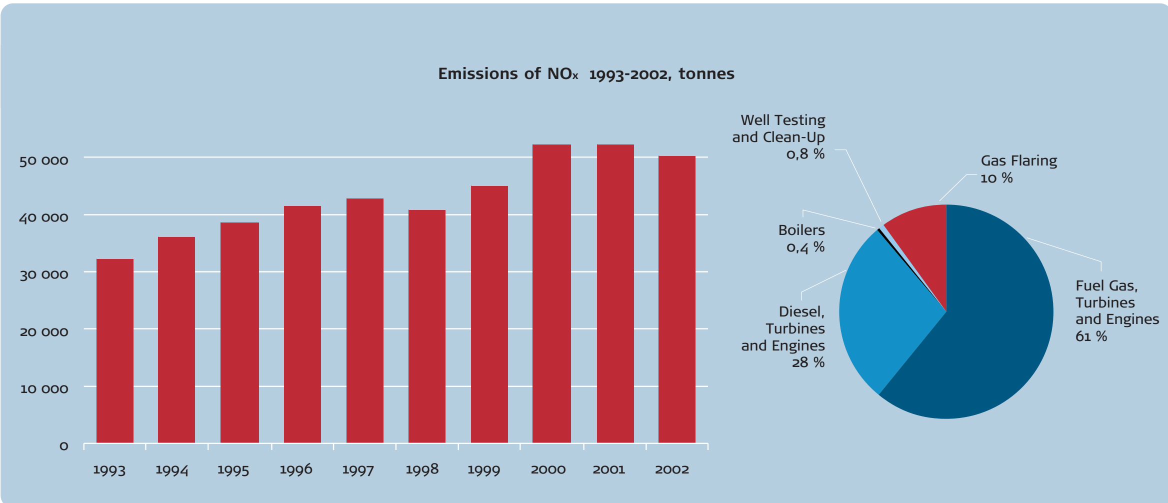

Figure 22 – Historical development of the total NOx emissions, in tonnes, and the 2002 distribution by source.

The total emissions of NOx were reported to 50 308 tonnes in 2002. This is a reduction of 1 814 tonnes or 3,5 % from 2001.

The historical development over the last decade may be described by the following main trends:

- From 1993 to 1997 (and partly also continuing to 2001), there was a stable increase in the emissions of NOx, mainly due to increased fuel gas consumption and increased use of diesel driven mobile rigs in the production activities.

- From 1997 to 1999, the NOx emissions decreased slightly due to increased usage of turbines with low-NOx emission combustion technology. Without the introduction of the low-NOx turbines, the strong increasing trend from 1993 would have continued.

- Approximately 50% of the reported increase in the NOx emissions from 1999 to 2000 is caused by transition to equipment specific emission factors.
- The reduction from 2001 to 2002 is mainly caused by reduced flaring and reduced use of diesel (less use of mobile installations).

Combustion in turbines, engines and boilers accounted for 89 % of the total NOx emissions in 2002. 10 % was related to flaring and the remaining 1 % to well testing/clean-up.

Figure 23 shows the specific emissions of NOx for the period from 1993 to 2002.

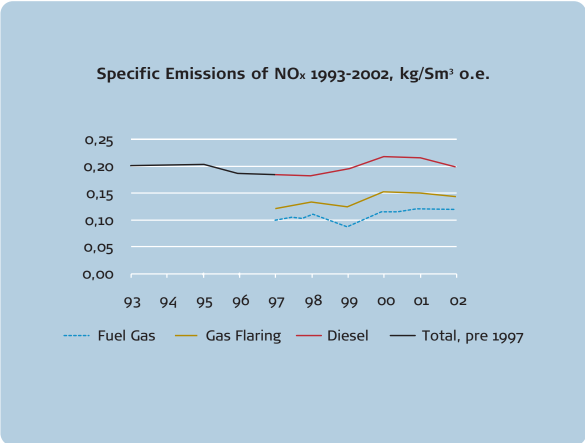

Figure 23 – Historical development: Emissions of NOx, kg per Sm^3 o.e. delivered.

The annual Norwegian emissions of NOx are approximately 214 000 tonnes[8]. Thus, the share contributed by the oil and gas industry is approximately 24 % (23 % in 2001).

6.7 nmVOC EMISSIONS

The nmVOC term includes all volatile organic compounds except methane. Figure 24 illustrates the historical development of these emissions from the NCS, and the 2002 distribution by source.

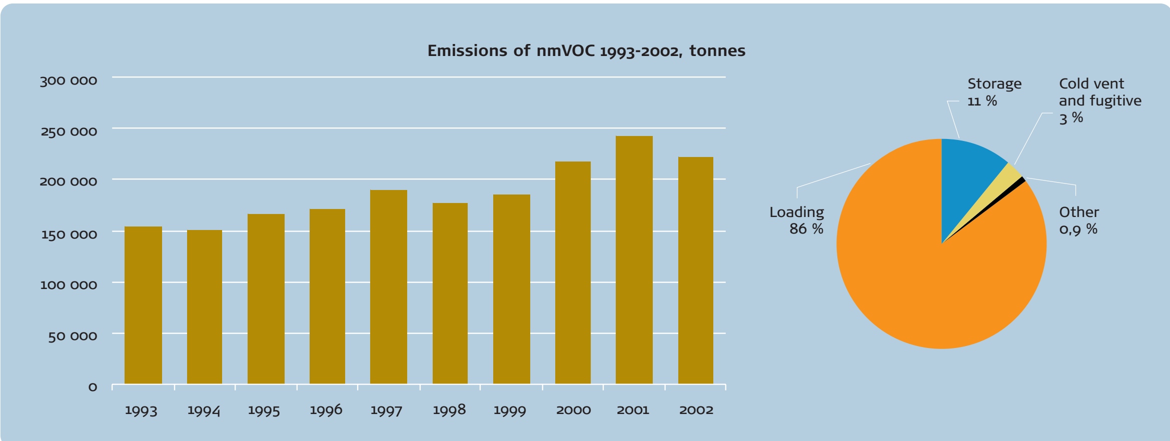

Figure 24 – Historical development of the nmVOC emissions[9], tonnes, and the 2002 distribution by source.

[8] Preliminary 2002 data from Statistics Norway.
[9] The operators did not report fugitive emissions during the period 1993 to 1996. The estimate used may represent emission figures of lower accuracy compared with other emission data.

The total nmVOC emissions in 2002 were 221 809 tonnes, which is a decrease of approximately 8 % compared with 2001[10]. The main reasons for the reduced emissions in 2002 compared with 2001 are reduction of nmVOC emissions from storage and loading of oil offshore due to decreased oil deliveries and emission reduction initiatives[11].

Of the total nmVOC emissions in 2002, 97 % came from oil storage and loading. This is in line with the share in the period from 1997 to 2001. Cold venting and small leakages are the main contributors to the remaining 3 % share of the nmVOC emissions. The reported nmVOC emissions from cold venting and fugitive emissions have increased with 3,1 % from 5 272 tonnes in 2001 to 5 435 tonnes in 2002, due to increased gas production.

The total annual Norwegian emissions of nmVOC are approximately 334 000[12] tonnes. The emissions from the Norwegian Continental Shelf contribute with 66 % of this (65 % in 2001).

6.8 CH_4 EMISSIONS

Figure 25 shows the historical development of the total methane emissions, and the emissions in 2002 distributed by source.

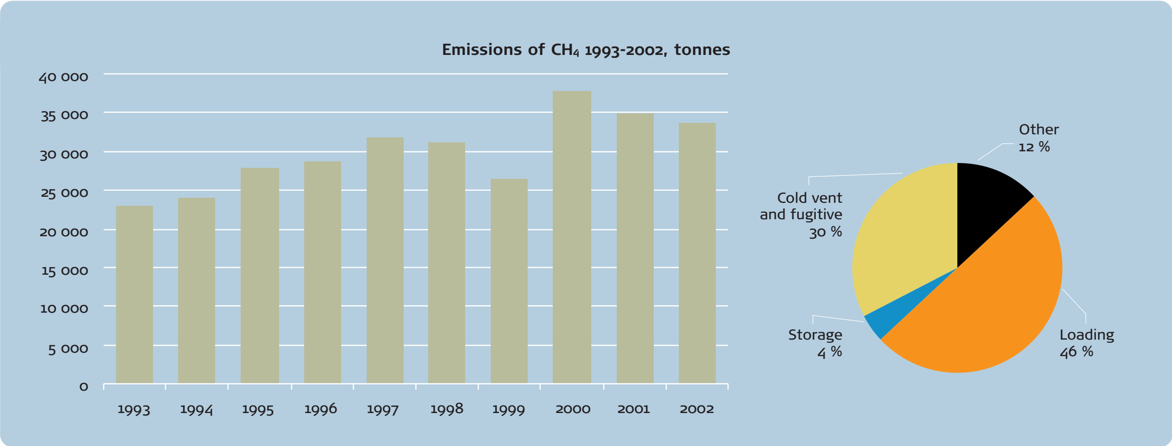

Figure 25 – The historical development of the total methane emissions[13], tonnes, and the 2002 distribution by source.

The total CH_4 emissions in 2002 were 33 723 tonnes, a decrease of 3 % since 2001. The two major sources for CH_4 emissions are cold venting and fugitive emissions from flanges, vents and various processing equipment (38 %) and oil storage and loading (50 %). Uncombusted CH_4 from gas turbine exhaust and flaring contributed with the remaining 12 %.

The main cause for the large variations in the reported emissions since 1999 is improved reporting routines of fugitives emissions on several fields.

Emitted methane gas contributes to the processes that control the global temperature. It has a global warming potential 21 times[14] higher than that of CO_2.

The total annual Norwegian emissions of CH_4 are approximately 330 000 tonnes[15].
The emissions from the petroleum activities represents approximately 10 % of the national methane emissions (11 % in 2001).

[10] On a resource split the emission data are different, due to the inclusion of onshore receival plants from 1998 onwards.
[11] The operators have established a Joint Industry Project to reduce the nmVOC emissions from shuttle tanker loading. The purpose of this activity is amongst others to ensure cost optimal implementation of nmVOC reducing technology onboard shuttle tankers in line with discharge permit requirements.
[12] Preliminary 2002 data from Statistics Norway.
[13] The operators did not report fugitive emissions during the period from 1993 to 1996. The estimate used may represent emission figures of lower accuracy compared with the other emission data. However, the new reporting format represents a considerable improvement on this point.
[14] According to the ICCP, based on a 100-year time frame.
[15] Preliminary 2002 data from Statistics Norway.

6.9 SOx EMISSIONS

Systematic reporting of SOx emissions started in 1997. Since then, the historical emission development has been as shown in Figure 26. The 2002 emissions are also shown as distribution by source.

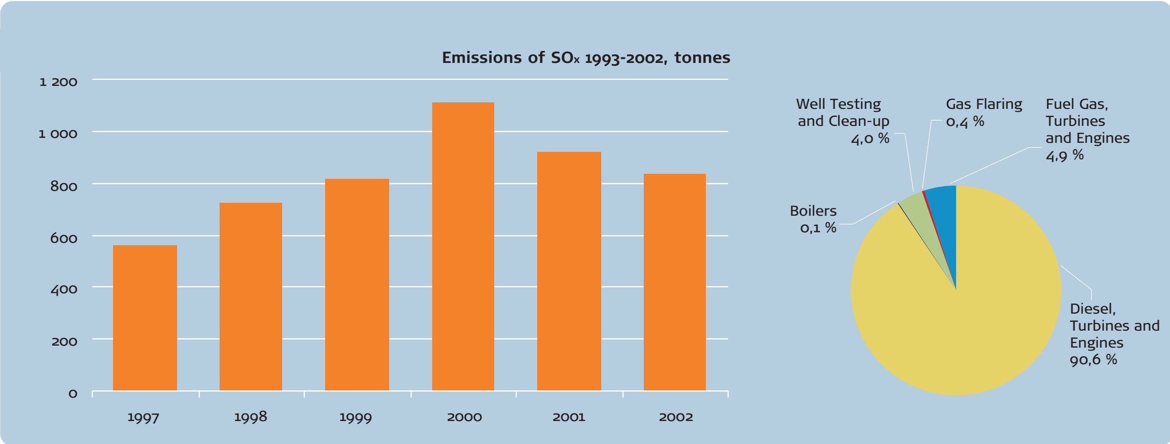

Figure 26 – The historical development of the total SOx emissions, tonnes, and the 2002 distribution by source.

In 2002, the total reported emissions were 832 tonnes. The emissions are low due to the low sulphur content in the fuel gases used in gas turbines and engines. As a result, the main source of SOx emissions from the petroleum industry is the combustion of diesel fuels.

The total annual Norwegian SO2 emissions in 2001 were 24 754 tonnes[16]. Thus, the petroleum industry is responsible for 3,4 % of the total emissions in Norway.

[16] Preliminary 2002 data from Statistics Norway.

7 ACCIDENTAL EMISSIONS AND DISCHARGES

Accidental emissions and discharges are classified into three main categories, with the following subgroups:

- **Oil:** Diesel fuel, fuel oils, crude oil, waste oils, other oils.
- **Chemicals and drilling fluids:** Corrosive substances, environmentally toxic substances, oil-based drilling fluid, other drilling fluids, flammables.
- **Accidental emissions to air:** Emissions of halon, other emissions to air.

Figure 27 shows the historical development for accidental discharges to sea.

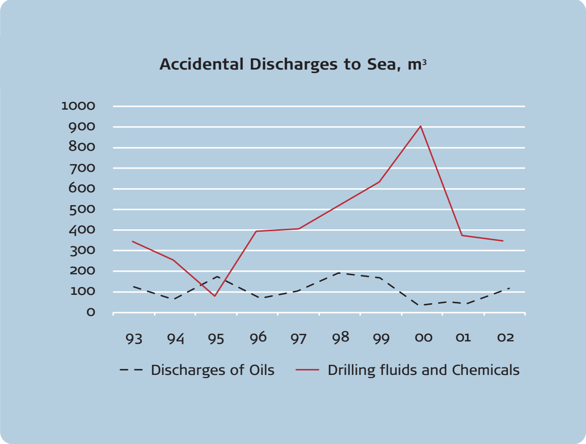

Figure 27 – Historical development of accidental discharges to sea (oil, chemicals and drilling fluids).

The total accidental discharges of different oils were 109 m^3 in 2002, caused by 247 incidents. This represents an increase from 50 m^3 and 227 incidents in 2001, respectively. 82 % of the total discharged oil volume was due to nine incidents of more than 1 m^3 each. No accidental discharges of oil have been reported from exploration activities.

Corresponding data for the accidental discharges to the sea of chemicals and drilling fluids were 344 m^3, compared to 371 m^3 in 2001, caused by 101 incidents (118 in 2001).

The exploration activities were responsible for 12 % of the incidents and 14 % of the accidental discharges of chemicals and drilling fluids in 2002. The corresponding explorations share in 2001 was 9 % of the incidents and 20 % of the discharged volumes.

The total accidental emissions to air were 8,3 tonnes in 2002, almost exclusively confined to emissions of natural gas. 6 tonnes of natural gas was emitted from a single incident.

8 WASTE

8.1 WASTE REPORTING

The reporting of waste is divided into hazardous wastes and industrial wastes. The reporting regulations cover all the waste transported onshore. The target for the operators is, as defined in the joint guidelines for waste management in offshore petroleum operations, to generate the least amount of waste as possible, and secondly to establish systems to maximize waste recycling.

8.2 HAZARDOUS WASTE

64 414 tonnes of hazardous wastes were brought onshore in 2002. The two predominating types of hazardous wastes were drilling waste and process water. These two types of wastes contributed with 91 % by weight of the total quantities of hazardous waste brought onshore.

In 2001 the reported quantity of hazardous waste was 68 835 tonnes. The decrease in generation of hazardous waste from 2001 to 2002 is 6 %.

8.3 INDUSTRIAL WASTE

15 803 tonnes of industrial waste (non-hazardous waste) were generated on the NCS in 2002 versus 20 339 tonnes in 2001. 65 % of these wastes were sorted according to various waste fractions in 2002 (67 % in 2001). The remaining 35 % were unsorted waste and incorrectly sorted waste (non-conformances). The main fraction by weight of sorted wastes is metal, which accounts for 55 %.

The exploration activities produced 609 tonnes of industrial waste. 70 % of this was sorted according to the various waste fractions.

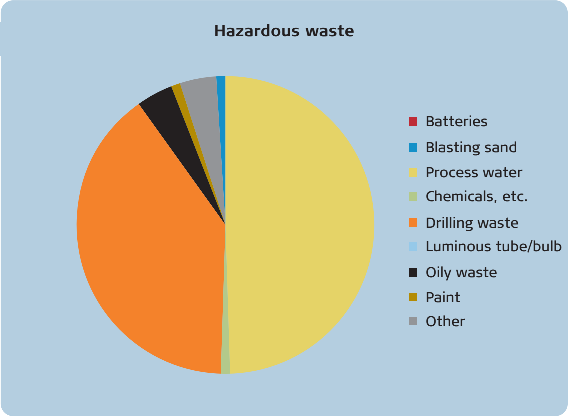

Figure 28 – Hazardous waste brought onshore from total activities on the NCS, 2002.

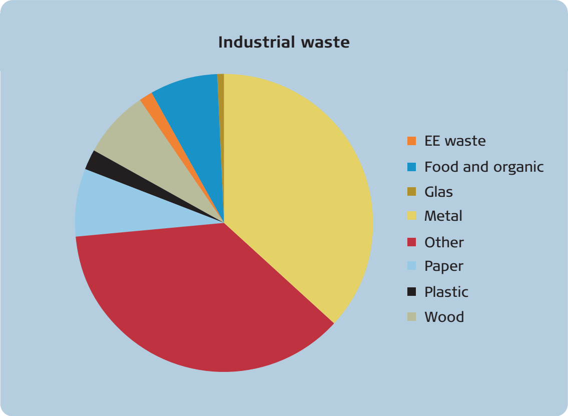

Figure 29 – Waste sorted according to waste fractions and residue waste from total activities on the Norwegian Continental Shelf, 2002.

9 WORDS AND ABBREVIATIONS

CH_4 Methane

CO_2 Carbon dioxide

(G) Geographical split
Data reported according to a geographical distribution. All Norwegian fields (not including Murchison) are included with their totals.

GHG Greenhouse Gases

NCS Norwegian Continental Shelf

MiBu Environmental toxicants prioritized for phase-out. Identified in Storting White Paper No. 58 (Miljøvernpolitikk for en bærekraftig utvikling).

nmVOC non-methane Volatile Organic Compounds

NO_x Nitrogen oxides

o.e. Oil equivalents
Conversion factor based on the energy content in hydrocarbons. Calculated in accordance with the definition from the NPD:

Hydrocarbon Product
Conversion from
Equivalent to

Oil
1 m^3
= 1 Sm^3 o.e.

Condensate
1 tonnes
= 1,3 Sm^3 o.e.

Gas
1 000 Sm^3
= 1 Sm^3 o.e.

NGL
1 tonnes
= 1,9 Sm^3 o.e.

OSPAR The Convention for the Protection of the Marine Environment of the North-East Atlantic

PLONOR Pose Little Or No Risk. Substances listed on the PLONOR list are naturally occurring in seawater, or are not environmentally hazardous.

(R) Resource split
Data reported according to the Norwegian shares of the production licences (being 100 % for all fields except Frigg and Statfjord). Includes also the Norpipe pipeline facilities (located outside the NCS). Onshore receiving plants were also included for the first time in 1998.

SFT Norwegian Pollution Control Authority (SFT)

Sm^3 Standard cubic meters

SO_x Sulphur oxides

SO_2 Sulphur dioxides

10 APPENDIX

10.1 OIL AND GAS ACTIVITIES

	Oil/Condensate mill. Sm^3o.e.	Gas sales mill. Sm^3o.e.	Total mill. Sm^3o.e.	Prod. Water mill. m^3
1988	67	29	96	10
1989	89	30	118	14
1990	97	26	123	16
1991	111	26	137	18
1992	127	27	153	23
1993	135	26	161	26
1994	150	30	180	34
1995	162	31	193	47
1996	181	41	222	67
1997	188	43	230	84
1998	179	44	223	100
1999	181	48	229	108
2000	190	50	240	116
2001	189	53	242	130
2002	185	65	251	136

Table 3 – Historical production data of oil/condensate and gas.

	Oil/Condensate Production (mill. Sm^3 o.e.)	Gas Production (mill. Sm^3 o.e.)	Gas Injection (mill. Sm^3 o.e.)	Produced water (mill. m^3)	Produced water injection (mill. m^3)
1998	179	73	24	100	8
1999	181	81	28	108	9
2000	190	90	39	116	10
2001	189	95	33	130	13
2002	185	106	36	136	17

Table 4 – Production and injection data for 1998-2002.

10.2 DRILLING

	Discharges of drilling fluids [m^3]	Consumption of drilling fluids [m^3]	Generated Cuttings [tonnes]
1997	176 555	214 851	91 906
1998	157 364	190 853	124 544
1999	174 864	198 929	94 097
2000	219 149	262 172	122 567
2001	186 379	223 442	95 867
2002	157 345	188 164	82 017

Table 5 – Key figures from drilling with water based drilling fluids.

	Consumption of Drilling Fluids [m^3]	Generated Cuttings and Drilling Fluids [tonnes]	Reinjected Quantities [tonnes]	Onshore Treatment [tonnes]
1997	49 344	68 913	47 979	23 895
1998	56 971	117 114	91 665	29 296
1999	45 873	97 364	73 643	30 798
2000	71 562	143 825	108 836	35 139
2001	63 785	184 561	160 878	25 412
2002	77 127	219 044	174 734	45 565

Table 6 – Key figures from drilling with oil-based drilling fluids.

	Reinjected Quantities	Discharges to sea	Onshore Treatment	Consumption of Drilling Fluids [m^3]	Generated Cuttings and Drilling Fluids
1997	15 085	19 898	2 694	19 727	33 001
1998	5 394	34 789	1 124	19 118	40 362
1999	438	33 381	124	18 550	33 945
2000	4 720	20 392	2 640	14 315	27 755
2001	1 307	12 590	11 672	14 848	25 569
2002	2 447	11 362	802	7 733	14 611

Table 7 – Key figures from drilling with synthetic-based drilling fluids, tonnes unless specified.

10.3 DISCHARGES TO SEA

	Produced water	Displacement and drainage water + jetting	Well testing and clean-up operations	Accidental discharges
1993	590	161	22	108
1994	842	193	35	57
1995	1 150	279	15	144
1996	1 451	304	22	61
1997	1 967	346	25	91
1998	2 135	395	19	155
1999	2 467	297	7	144
2000	2 738	342	5	29
2001	2 857	318	13	42
2002	2 572	277	5	92

Table 8 – Historical development of oil discharges to the sea from different sources, tonnes.

	Oilprod.	Produced water	Disch. prod. water	Watercut		Oil concentration
	mill. m^3	mill. m^3	mill. m^3	Water/Oil	Water % of total	[mg/l]
1985	47					
1986	51	3,8		0,07	6,95 %	
1987	59	6,3		0,11	9,58 %	
1988	67	10,0		0,15	12,95 %	
1989	89	14,4		0,16	13,99 %	
1990	97	16,3		0,17	14,33 %	
1991	111	17,5		0,16	13,61 %	
1992	127	22,5	22,5	0,18	15,10 %	
1993	135	25,9	25,9	0,19	16,12 %	22,8
1994	150	34,1	34,1	0,23	18,48 %	24,7
1995	162	47,3	47,3	0,29	22,63 %	24,3
1996	181	66,6	66,6	0,37	26,92 %	21,8
1997	188	83,6	77,5	0,45	30,84 %	25,4
1998	179	100,2	92,0	0,56	35,88 %	23,2
1999	181	108,0	98,9	0,60	37,39 %	24,9
2000	190	116,1	106,0	0,61	37,93 %	25,8
2001	189	130,0	116,1	0,69	40,75 %	24,6
2002	185	136,3	118,9	0,74	42,40 %	21,6

Table 9 – The historical data on the relation between produced quantities of water and oil.

	1997	1998	1999	2000	2001	2002
Arsenic	78	81	4 440	966	1 095	370
Cadmium	1 495	294	93	115	113	46
Chromium	1 575	1 012	1 144	492	249	119
Copper	1 373	1 648	1 654	412	431	2 212
Lead	2 304	268	1 343	520	317	875
Mercury	27	39	16	5	5	6
Nickel	3 104	2 464	2 330	751	748	209
Zink	2 534	1 985	16 488	14 914	9 138	13 576
Total	12 488	7 791	27 508	18 175	12 096	17 412

Table 10 – Heavy metals discharged with produced water, kg.

	1998	1999	2000	2001	2002
Organic acids	29 571	29 247	28 070	27 625	29 056
BTX	2 859	761	1 015	1 034	1 065
Phenols	1 605	480	167	188	244
Alkyl phenols (C1 - C3)	31	14	426	300	196
Alkyl phenols (C4 - C9)	0	0	32	18	8
PAH	143	40	43	42	47

Table 11 – Selected groups of hydrocarbons discharged with produced water, tonnes.

	Discharges [kg]
Benzene	552 074
Toluene	358 638
Etyl Benzene	24 709
Xylene	154 469
Total BTEX	**1 089 889**
Naphtalene*	43 622
C1-naphtalene	51 647
C2-naphtalene	20 667
C3-naphtalene	11 453
Phenantrene*	1 821
Antrasene*	41
C1-Phenantrene	1 980
C2-Phenantrene	2 177
C3-Phenantrene	737
Dibenzotiophene	482
C1-dibenzotiophene	1 230
C2-dibenzotiophene	1 282
C3-dibenzotiophene	9 191
Total NPD	**146 330**
Acenaphtylene*	32
Acenaphtene*	226
Fluorene*	1 200
Fluoranten*	47
Pyrene*	52
Krysene*	68
Benzo(a)antrasene*	30
Benzo(a)pyrene*	10
Benzo(g,h,i)perylene*	12
Benzo(b)fluorantene*	16
Benzo(k)fluorantene*	15
Benzo(b,j,k)fluorantenes	0,3
Indeno(1,2,3-c,d)pyrene*	6
Dibenz(a,h)antrasene*	8
Total 16 EPA-PAH (marked)	**47 204**
Total all PAH (incl NPD)	**148 050**
Phenol	243 552
C1-Phenol	126 233
C2-Phenol	51 089
C3-Phenol	19 143
C4-Phenol	5 963
C5-Phenol	1 972
C6-Phenol	95
C7-Phenol	59
C8-Phenol	36
C9-Phenol	75
Total Phenols	**448 218**
Methanoic acid	65 731
Ethanoic acid	24 589 099
Propanoic acid	3 499 924
Buthanoic acid	644 737
Penthanoic acid	256 215
Total Organic acids	**29 055 705**
Methanol	910 306

Table 12 – Organic compounds discharged with produced water in 2002, kg.

10.4 CHEMICALS

	Use	Discharge	Injection
1994	295 523	156 789	
1995	320 535	146 946	
1996	366 480	162 298	
1997	404 725	202 484	
1998	382 624	155 629	57 778
1999	352 540	175 708	46 532
2000	497 015	202 699	78 354
2001	434 591	180 329	75 428
2002	604 112	176 604	94 940

Table 13 – Use, discharges and injection of chemicals, tonnes.

	Kg Use per Sm^3 o.e.	Kg Discharges per Sm^3 o.e.
1994	1,64	0,87
1995	1,66	0,76
1996	1,65	0,73
1997	1,76	0,88
1998	1,71	0,70
1999	1,54	0,77
2000	2,07	0,85
2001	1,79	0,74
2002	2,41	0,70

Table 14 – Specific use and discharges of chemicals.

	g Use per Sm^3 o.e.	g Discharges per Sm^3 o.e.
1997	116	18
1998	143	26
1999	118	33
2000	101	32
2001	111	37
2002	82	33

Table 15 – Specific use and discharges of production chemicals.

Operational group	Used [tonnes]	Discharged [tonnes]	Injected [tonnes]
Drilling and well chemicals	532 103	143 203	89 251
Production chemicals	20 584	8 366	1 579
Injection chemicals	11 111	103	1 093
Pipeline chemicals	1 231	1 225	0
Gas treatment chemicals	14 796	10 646	411
Utility chemicals	4 106	2 526	161
Chemicals added to the export flow	14 320	9	0
Chemicals from upstream facilities	64	9 913	0
Water trace components	1	1	0
Total	598 317	175 991	92 494

Table 16 – Use, discharge and injection of chemicals in 2002, distributed by operational groups.

	Green	Yellow	Red	Black	Water
1997	72 %	25 %	2,48 %	0,14 %	0 %
1998	91 %	7 %	1,56 %	0,02 %	30 %
1999	93 %	5 %	1,06 %	0,01 %	28 %
2000	92 %	7 %	0,66 %	0,01 %	32 %
2001	93 %	7 %	0,62 %	0,03 %	29 %
2002	93 %	6 %	0,58 %	0,02 %	35 %

Table 17 – Discharges of chemicals for 1998-2002, distributed by environmental categories.
Water is included in the "Green" category.

	Water	Green	Yellow	Red	Black
2002	35 %	58 %	6 %	0,58 %	0,02 %

Table 18 – Distribution of total discharges on chemicals in 2002.

Substance	Total Additives	Total Contaminants
Mercury		20
Cadmium		53
Zink	274	4 287
Lead	28	3 992
Chrome		670
Nickel		331
Copper	704	3 080
Arsenic		104
Organotin		0,5
Other organo halogenes		
Alkyl phenol ethoxylate		
PAH		

Table 19 – Discharges of environmental harmful additives and contaminants in chemicals in 2002, kg.

	Additives	Contaminants
1997	20,4	21,7
1998	13,2	46,4
1999	10,5	18,5
2000	11,3	33,9
2001	3,3	9,9
2002	1,0	13,1

Table 20 – Discharges of environmental harmful compounds in chemicals 1997-2002, tonnes.

10.5 EMISSIONS TO AIR

Year	Fuel gas [mill. Sm^3]	Flare gas [mill. Sm^3]	Diesel [1000 tonnes]
1990	1 932	556	123
1991	2 092	356	164
1992	2 429	309	134
1993	2 533	346	137
1994	2 626	382	189
1995	2 594	414	177
1996	2 781	447	193
1997	2 751	396	229
1998	3 029	452	185
1999	2 685	688	267
2000	3 190	705	270
2001	3 670	562	259
2002	3 786	452	241

Table 21 – Fuel gas and diesel consumption and flared gas volumes. Well testing and well maintenance not included.

	Burned oil [tonnes]	Burned diesel [tonnes]	Burned gas [Sm^3 o.e.]
1997	29 697	0	11 708
1998	22 527	325	17 859
1999	16 498	1 336	12 086
2000	12 121	34 844	7 187
2001	32 142	325	26 310
2002	12 792	366	30 950

Table 22 – Well testing and well clean-up operations.

	CO_2	NO_x	nmVOC	CH_4	SO_x
1997	1,7 %	6,2 %	0,1 %	0,00242 %	17,4 %
1998	1,7 %	5,9 %	0,1 %	0,00381 %	15,7 %
1999	0,7 %	2,9 %	0,0 %	0,00015 %	6,2 %
2000	0,8 %	3,4 %	0,1 %	0,00011 %	6,2 %
2001	0,8 %	3,5 %	0,1 %	0,00020 %	9,1 %
2002	1,1 %	4,9 %	0,1 %	0,00138 %	13,7 %

Table 23 – Exploration-related share of total emissions from the NCS.

	CO_2 emissions [mill. tonnes]
1993	7,120
1994	7,624
1995	7,704
1996	8,377
1997	8,491
1998	9,037
1999	9,332
2000	10,457
2001	11,364
2002	11,235

Table 24 – Historical CO_2 emissions.

	2002
Gas Flaring	9,9 %
Fuel Gas, Turbines, Engines and boilers	82,2 %
Diesel, Turbines, Engines and boilers	6,9 %
Well Testing and Clean Up	1,0 %

Table 25 – CO2 emission distribution by source.

	NO_x emissions [tonnes]
1993	32 100
1994	36 200
1995	38 685
1996	41 298
1997	42 699
1998	40 699
1999	44 978
2000	52 261
2001	52 122
2002	50 308

Table 26 – Historical NOx emissions.

	2002
Gas Flaring	10,2 %
Fuel Gas, Turbines and Engines	60,5 %
Diesel, Turbines and Engines	28,1 %
Boilers	0,4 %
Well Testing and Clean Up	0,8 %

Table 27 – NOx emission distribution by source.

	nmVOC emissions [tonnes]
1993	154 520
1994	151 520
1995	165 820
1996	171 030
1997	190 288
1998	177 372
1999	185 641
2000	218 120
2001	241 886
2002	221 809

Table 28 – Historical nmVOC emissions.

	2002
Gas Flaring	0,1 %
Fuel Gas, Turbines and Engines	0,4 %
Diesel, Turbines and Engines	0,4 %
Boilers	0,0 %
Well Testing and Clean Up	0,0 %
Loading	85,5 %
Storage	11,1 %
Cold vent and fugitive	2,5 %

Table 29 – nmVOC emission distribution by source.

	CH_4 emissions [tonnes]
1993	22 900
1994	23 900
1995	28 000
1996	28 800
1997	31 732
1998	31 083
1999	26 393
2000	37 682
2001	34 937
2002	33 723

Table 30 – Historical CH_4 emissions.

	2002
Gas Flaring	1,2 %
Fuel Gas, Turbines and Engines	10,3 %
Diesel, Turbines and Engines	0,0 %
Boilers	0,3 %
Well Testing and Clean Up	0,0 %
Loading	46,4 %
Storage	3,9 %
Cold vent and fugitive	38,0 %

Table 31 – CH4 emission distribution by source.

	SO_x emissions [tonnes]
1997	561
1998	725
1999	815
2000	1 109
2001	919
2002	832

Table 32 – Historical SOx emissions.

	2002
Gas Flaring	0,4 %
Fuel Gas, Turbines and Engines	4,9 %
Diesel, Turbines and Engines	90,6 %
Boilers	0,1 %
Well Testing and Maintenance	4,0 %

Table 33 – SOx emission distribution by source.

10.6 ACCIDENTAL DISCHARGES

	Discharges of Oils	Drilling fluids and Chemicals
1993	128	338
1994	68	250
1995	172	75
1996	73	388
1997	108	404
1998	184	509
1999	171	627
2000	35	898
2001	50	371
2002	109	344

Table 34 – Accidental discharges to sea, m^3.

10.7 WASTE

Hazardous waste	2002	Share
Batteries	72	0 %
Blasting sand	182	0 %
Process water	33 030	51 %
Chemicals, etc.	170	0 %
Drilling waste	25 267	39 %
Luminous tube/bulb	36	0 %
Oily waste	2 605	4 %
Paint	346	1 %
Other	2 705	4 %
Totalt	64 414	100 %

Table 35 – Hazardous waste main groups brought onshore from total activities on the NCS, 2002.

Industrial waste	2002	Share
EE waste	189	1 %
Food and organic	1 444	9 %
Glas	67	0 %
Metal	5 665	36 %
Other	5 565	35 %
Paper	1 269	8 %
Plastic	232	1 %
Wood	1 372	9 %
Total	15 803	100 %

Table 36 – Wast sorted according to waste fractions and residue waste from total activities on the NCS, 2002.

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The **OLF** is a professional body and employers' association for oil and supplier companies engaged in the field of exploration and production of oil and gas on the Norwegian continental shelf.

The **OLF** is a member of the Confederation of Norwegian Business and Industry (NHO).

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