2016 ENVIRONMENTAL REPORT

ENVIRONMENTAL WORK BY THE OIL AND GAS INDUSTRY

FACTS AND DEVELOPMENT TRENDS

Norsk olje&gass

The Norwegian Oil and Gas Association (formerly the Norwegian Oil Industry Association) is an interest organisation and employer's association for oil and supplier companies related to exploration for and production of oil and gas on the Norwegian continental shelf (NCS). Norwegian Oil and Gas represents just over 100 member companies, and is a national association in the Confederation of Norwegian Enterprise (NHO).

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1 FOREWORD

THE NORWEGIAN OIL AND GAS ASSOCIATION PUBLISHES AN ANNUAL ENVIRONMENTAL REPORT CONTAINING A DETAILED OVERVIEW OF ALL EMISSIONS/DISCHARGES FROM THE PETROLEUM INDUSTRY IN THE PREVIOUS YEAR. ITS PURPOSE INCLUDES IMPARTING EMISSION/DISCHARGE DATA AS WELL AS THE INDUSTRY'S WORK AND RESULTS IN THE ENVIRONMENTAL AREA.

The Norwegian petroleum industry has a clear ambition: it will be a world leader in the environmental sphere. That calls for constant improvement. Detailed reporting of emissions and discharges is essential for measuring progress and how far goals are met.

This report derives its information from Epim Environment Hub (EEH), a joint database for Norwegian Oil and Gas, the Norwegian Environment Agency (NEA) and the Norwegian Petroleum Directorate (NPD). Pursuant to the Environment Act, all operators on the NCS must submit annual emission/discharge reports in accordance with the requirements specified in the activities regulations and set out in detail in the NEA guidelines for reporting from offshore petroleum activities (M-107 2014). Where the operator companies are concerned, these requirements mean that all emissions/discharges and all waste generated from operations on the Norwegian continental shelf (NCS) must be reported in detail on an annual basis. In addition to sending the emission/discharge report for each field to the NEA, all the data must be posted to the EEH. That applies both to planned and officially approved operational emissions/discharges and to those which occur accidentally. Common parameters ensure consistent emission/discharge reporting from all production licences.

This environmental report contains a synthesis of all emissions/discharges, as well as a summary of results from research projects related to the marine environment and environmental monitoring.

The definition of the petroleum industry accords with the one provided in the Norwegian Petroleum Tax Act. Emissions/discharges from the construction and installation phase, maritime support services and helicopter traffic are therefore excluded from this report. Statistics Norway and the NEA also report emission/discharge figures for the petroleum industry. These can vary from the quantities reported in this document because the petroleum industry is delimited by varying criteria in different contexts. Reporting of greenhouse gas (GHG) emission allowances, for example, is delimited differently from the Petroleum Tax Act.

This English version is a translation of the Norwegian report. Electronic versions in both English and Norwegian are published on the Norwegian Oil and Gas website at www.norskoljeoggass.no. The field-specific emission/discharge reports submitted to the NEA can also be downloaded from the site.

2 SUMMARY

THE NORWEGIAN PETROLEUM SECTOR HAS BEEN THROUGH A DEMANDING YEAR, WITH A SHARP FALL IN OIL PRICES. DRILLING OF PRODUCTION AND EXPLORATION WELLS WAS NEVERTHELESS MAINTAINED AT A RELATIVELY HIGH LEVEL. PRODUCTION FROM THE NCS ALSO GREW BY 5.4 PER CENT, WITH OIL OUTPUT RISING AS WELL FOR THE SECOND YEAR IN A ROW.

Recovery factors for reservoirs in ever-older fields remain high on the NCS, which calls for a great deal of energy. Nevertheless, GHG emissions per unit produced by Norway's offshore sector declined in 2015. Norwegian emissions per tonne of oil equivalent (oe) for 2014 (most recent international figures) were less than 44 per cent of the global average.

NO_x emissions fell markedly in 2015, reflecting a slowdown in activity with reduced use of mobile rigs. Despite a high level of drilling, discharges from these operations are declining and environmental monitoring shows that they have no significant impact beyond about 500 metres from the release point. The oil concentration in produced water discharges fell in 2015 for the second year in a row despite more demanding output from aging fields, and was roughly 60 per cent below the official threshold. Unintentional discharges of oil, including crude, are continuing to decline because of the high priority given by the operators to preventive measures.

Combined with the steadily rising level of costs in recent years, the sharp drop in oil prices since the summer of 2014 has made it very important for the players on the NCS to reduce their costs to a sustainable level. While investment remains at a record high, it is down compared with the past few years. That has also led to reductions in a number of emission/discharge types.

Although production has risen both in total and for oil during the recent past, the Norwegian Petroleum Directorate (NPD) expects overall output from the NCS to fall somewhat over the next few years. Some renewed decline in oil production could occur towards the end of the present decade, while the reduction for gas is expected to be more moderate. Only small changes are forecast for condensate and natural gas liquids (NGL) during this period. After 45 years of petroleum operations on the NCS, more than half the estimated resources remain to be recovered. The NPD has upgraded its estimate of resources in the Barents Sea on the basis of new data. With the 23rd licensing round, these waters will become more important in the time to come.

Global warming is one of the biggest challenges of the age, and sharp reductions in anthropogenic GHG emissions are essential to avoid the worst consequences. Aging oil fields combined with a high recovery factor in international terms on the NCS pose challenges for energy consumption during production and thereby also for emissions to the air. Despite this, GHG – including CO_2 – emissions per unit produced declined for the second year in a row to reach about 66 kilograms per tonne of oe produced in 2015. That is just under 44 per cent of the international average. The petroleum sector on the NCS works continuously to reduce its emissions, including GHGs, and a number of processes have been initiated to reinforce this work in coming years.

However, CO_2 emission figures for 2015 showed some rise from the year before owing to increased petroleum production. Operations on the NCS released 13.5 million tonnes of CO_2 overall, compared with 13.1 million in 2014. Annual emissions have varied between 12 and 13 million tonnes since 2007. Including the other GHGs with associated accepted climate factors, emissions totalled 14.2 million tonnes of CO_2 equivalent compared with 13.9 million in 2014.

Methane (CH_4) emissions totalled 28 947 tonnes in 2015, down by just over 2 500 tonnes from the year before. The proportion emitted from loading oil into shuttle tankers has fallen drastically and is now less than six per cent of the total. Cold venting and diffuse emission from flanges, valves and various types of process equipment are the main sources of CH_4 released by the oil and gas industry. Total emissions of non-methane volatile organic compounds (nmVOC) in 2015 were 46 554 tonnes, down from 49 755 tonnes the year before. Efforts to avoid leaks have long been given priority on the NCS for both safety and environmental reasons. New EU figures show that CH_4 emissions from leaks in the transport system linking the NCS with European consumers total about 0.6 per cent of the sales volume. That supports the view that natural gas is a good climate alternative to coal for electricity generation from power stations. A collaboration project has been pursued with the NEA to improve emission data for volatile compounds, including CH_4, on the NCS. The preliminary results indicate that the amounts released are somewhat lower than previously estimated.

Petroleum operations emitted a total of 46 757 tonnes of NO_x in 2015, a marked decline from 52 375 tonnes the year before. This reduction reflected lower emissions from engines because the use of mobile units fell. The oil and gas sector is a substantial contributor to the environmental agreement on NO_x, which regulates the commitments made to the government by Norway's industry associations on reducing their overall emissions of these gases through a fund model. Norway has already met its NO_x commitments for 2020 under the Gothenburg Protocol. Efforts to reduce emissions through the NO_x fund have been crucial for this result. A positive supplementary effect is that measures to emit less NO_x by reducing fuel consumption also cut the amount of CO_2 released. The overall effect of the NO_x fund's portfolio is a cut of about 560 000 tonnes per annum in CO_2 emissions.

Discharges to the sea derive primarily from drilling wells and from the produced water which comes up with the oil. On new fields, produced water consists exclusively of the amount already present in the reservoirs. However, its quantity increases as the field ages because water is injected to maintain reservoir pressure and improve the oil recovery factor. Treated seawater is normally used. Produced water discharges have been stable in recent years at around 130 million standard cubic metres (scm) per annum. They nevertheless rose to just over 140 million scm in 2014 and 148 million scm in 2015. On certain fields where conditions are appropriate, all or part of the produced water is injected back into the sub-surface. Such injection increased substantially in 2002 and has been around 20 per cent of the total quantity in recent years. Just over 22 per cent was injected in 2015. Produced water represents the most important source of oil discharges on the NCS. The water is treated before release with the aid of technologies which differ between the various fields. The oil content in produced water averaged 12.3 milligrams per litre across the NCS in 2015 – down slightly from 2014. The official threshold is 30 mg/l.

Drilling discharges primarily comprise rock particles (drill cuttings) from the borehole and drilling fluid. Discharges are only permitted from wells drilled with water-based fluid, or when contamination from oil-based fluid is less than 10 grams of base oil per kilogram of cuttings. Despite a high level of drilling for both exploration and production wells in 2015, discharges declined from 2014.

The use and discharge of chemicals is strictly regulated in Norway. Chemicals are assessed on the basis of their environmental properties and criteria laid down in the HSE regulations with associated guidelines. Chemical additives are divided into four categories (green, yellow, red and black), where green substances have little or very limited environmental impact while black can only be discharged in special circumstances – where this is crucial for safety, for instance. The operators are required to make regular assessments of which chemicals can be replaced with less environmentally harmful alternatives – known as the substitution duty. Extensive substitution of chemicals has reduced the release of the most environmentally harmful substances to a fraction of what it was only 10 years ago. However, a marked increase in reported discharges of black chemicals – and to some extent red as well – occurred in 2011-14. This trend appears to have been reversed for black substances in 2015. The 6.6 tonnes of these chemicals released in that year was down by 13.9 tonnes from 2014. Discharges of red chemicals rose from 14.3 tonnes in 2014 to 67 tonnes.

Complex factors underlie the variations in recent years, but changed requirements for both reporting and substitution efforts are the most important. Discharges of fire extinguishing foam were not reported earlier because this was a safety chemical with no alternative products able to offer satisfactory extinguishing properties. It was accordingly exempted from the substitution and reporting duties. Alternatives to certain foams with less environmentally harmful properties are now available. These are now being phased in, but it will be several years before all fields on the NCS have replaced the old types with new versions.

The number of unintentional oil spills continued to decline in 2015.

3 LEVEL OF ACTIVITY ON THE NCS

NORWAY'S PETROLEUM INDUSTRY HAS BEEN THROUGH A DEMANDING YEAR. THE SHARP DROP IN OIL PRICES MEANS THAT THE BRAKES HAVE BEEN APPLIED.

Costs are being cut and thousands of employees have had to leave the industry. While oil prices are starting to recover as the summer of 2016 approaches, adjustment to a lower level of costs must nevertheless continue. A more competitive industry is ready to meet new challenges.

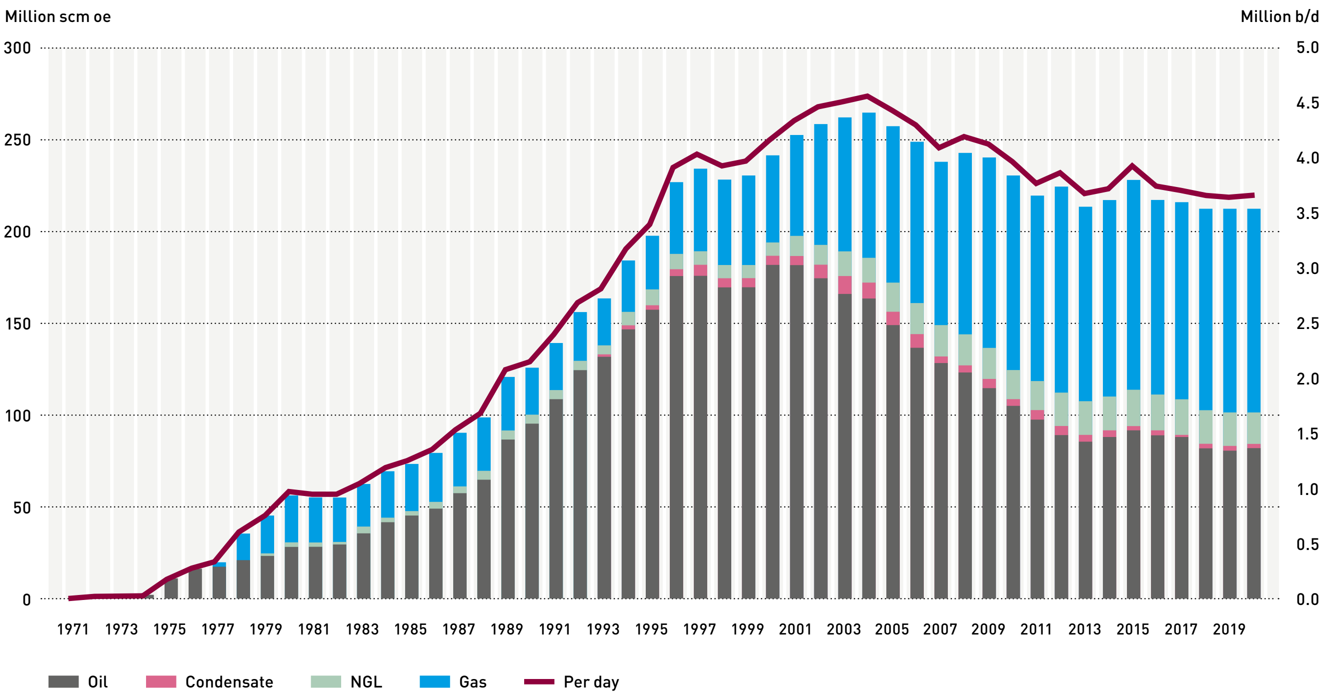
The oil and gas industry has been through a demanding year. Combined with the steadily rising level of costs in recent years, the sharp drop in oil prices since the summer of 2014 has made it very important for the players on the NCS to reduce their costs to a sustainable level. This has led to more than 30 000 jobs being shed in the sector, while investment has fallen from the high level experienced in recent years. The signs are that oil prices have ceased declining, and a moderate recovery has been seen since the beginning of 2016. With a continued concentration on cost developments, the petroleum industry could again become an important engine in the Norwegian economy.

PRODUCTION LIKELY TO FALL OVER NEXT FEW YEARS

A high level of exploration activity and new discoveries during recent years have laid the basis for a new rise in production from the NCS. Output in 2015 totalled 230.2 million scm oe, up by 11.8 million or 5.4 per cent from the year before. It was nevertheless 12.9 per cent below the peak year of 2004. The NPD expects overall output from the NCS to fall somewhat over the next few years. Some renewed decline in oil production could occur towards the end of the present decade, while the reduction for gas is expected to be somewhat more moderate. Only small changes are forecast for condensate and NGL during this period. After 45 years of petroleum operations on the NCS, more than half the estimated resources remain to be recovered. Uncertainty over production developments in coming years relates primarily to exploration trends and future oil and gas prices. A total of 57 and 56 exploration wells were spudded in 2014 and 2015 respectively. Partly because

FIGURE 01 **PRODUCTION ON THE NCS, HISTORICAL DEVELOPMENT AND FORECAST** (MILL SCM OE/MILL B/D)

Source: NPD



of the decline in oil prices, the NPD estimates that about 30 such wells will be drilled in 2016 – including 15-20 in the North Sea.

OIL PRODUCTION – DECLINE TOWARDS 2020

Oil production totalled 91 million scm in 2015, corresponding to 1.57 million barrels per day and up by 3.2 million scm or 3.7 per cent from the year before. Completing several large projects on producing fields, bringing new fields on stream and drilling many wells contributed to a renewed rise in crude output over the past couple of years. The 2015 figure was nevertheless 49.8 per cent down from the 2000 peak. According to the NPD's production forecast for the coming five years, a relatively flat trend over the next couple of years will be replaced by a new decline towards the end of the period. Oil production in 2020 is predicted to be 10.2 per cent lower than in 2015.

GAS REVENUES TOPPED OIL EARNINGS IN 2015

Sales of gas from the NCS totalled 114.9 billion scm in 2015, up by 6.1 billion scm or 5.6 per cent from the year before. Gas production has exceeded oil output over the past five years, while revenues from gas also exceeded oil earnings for the first time in 2015. However, the NPD's forecast up to 2020 shows a slowly declining trend, and gas production at the end of the decade is expected to be down by 3.4 per cent from 2015.

LIQUID PRODUCTION SET TO FALL

NGL output totalled 19.6 million scm oe in 2015, up by 0.65 million scm oe or 3.4 per cent from the year before. The NPD estimates that this figure will decline by 12.9 per cent up to 2020. In line with the declining trend of recent years, condensate production declined by 0.4 million scm oe or 14.8 per cent from 2014 to reach 2.5 million scm oe. The NPD expects a moderate fall in condensate output up to 2020. Overall liquid production from the NCS is forecast to decline from roughly 113 million scm oe in 2015 to 101 million by 2020.

BARENTS SEA MORE IMPORTANT IN FUTURE

Three years have passed since the NPD published its previous review of undiscovered resources on the NCS in 2013. Since then, 57 new discoveries have been made. Most of these are close to existing infrastructure and can be developed easily and cost-effectively. At the same time, the NPD's estimate for undiscovered resources has changed little.

FIGURE 02 RESOURCE GROWTH AND PRODUCTION ON THE NCS (MILL SCM OE)

Source: NPD

Expectations for the North and Norwegian Seas have been downgraded somewhat, but these are offset by an increase for the Barents Sea. The latter rise primarily reflects the geological information provided by exploration results in recent years.

LESS THAN HALF OF RESOURCES PRODUCED

Forty-seven per cent of the total forecast resources on the NCS have so far been produced, with undiscovered quantities estimated to account for 20 per cent. The overall expected value for recoverable resources on the NCS at 31 December 2015 was 14.2 billion scm oe. Of this, 6.6 billion has been sold and delivered and the remaining resources are put at NOK 7.6 billion. Total remaining resources could thereby sustain oil and gas production for many decades to come.

50TH ANNIVERSARY FOR NCS

The 50th anniversary of the first exploration well to be spudded on the NCS falls this year. Discoveries since 2000 have contributed assets worth more than NOK 2 000 billion, excluding exploration costs. Both exploration activity and resource growth during this period have clearly been at their highest in the North Sea, where the Johan Sverdrup field is making the biggest contribution to value creation. Exploration has also created substantial value in the Norwegian and Barents Seas. At the same time, the diversity of the companies has increased. A growing array of players involved in exploration operations has also boosted the number of operators for discoveries and fields. While there were eight operators of producing fields in 2000, that figure had risen to 15 in 2015.

A total of 53 companies were active on the NCS at 31 December 2015. The petroleum industry has been and will remain an important sector in the Norwegian economy.

INVESTMENT DECLINING, BUT STILL HISTORICALLY HIGH

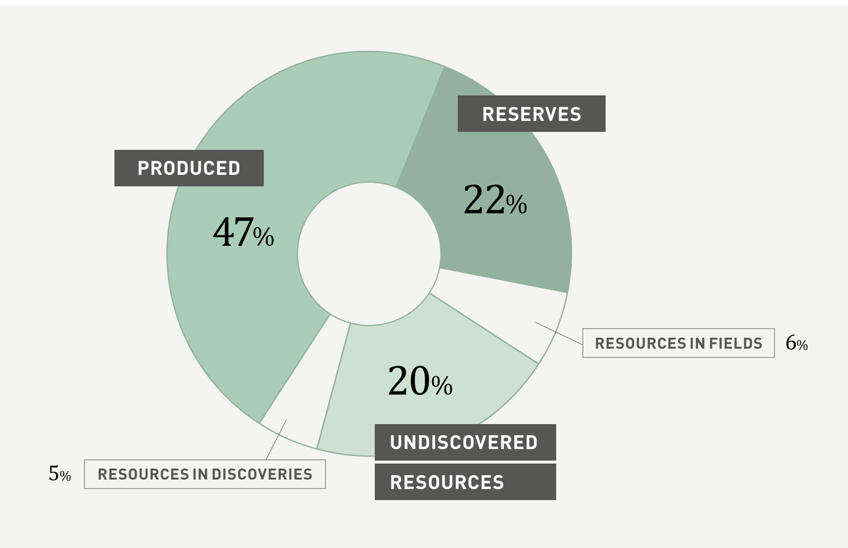
According to the investment survey from Statistics Norway, capital spending on oil and gas operations – including pipeline transport – totalled NOK 189.6 billion in 2015. This represented a decline of 11.5 per cent from the year before. The survey's estimate for the first quarter of 2016 put investment for the year at NOK 163.9 billion. That marks a return to the 2011-12 level, and thereby remains high in a historical context. While the investment downturn must be related to the sharp fall in oil prices, it primarily reflects company efforts to reduce costs.

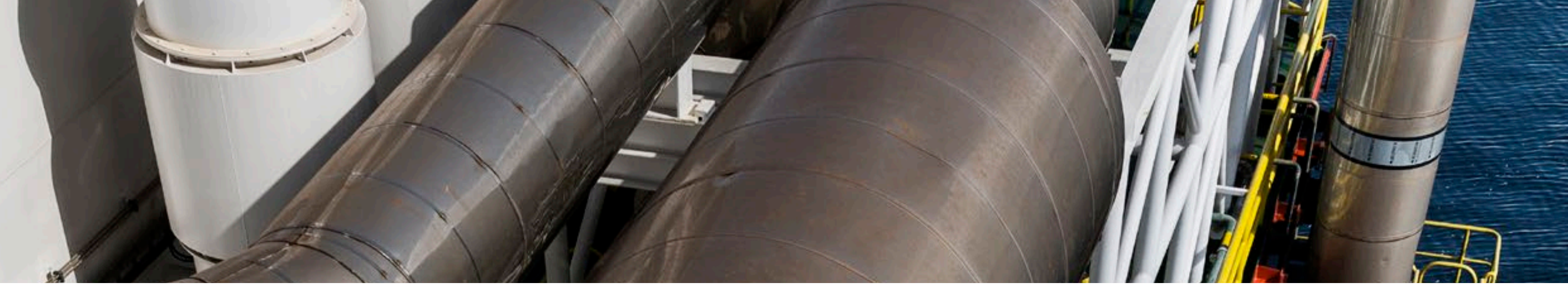
BIG INTEREST IN 23RD ROUND

New exploration acreage is crucial for long-term activity and value creation in the petroleum sector, and thereby also for employment by the industry. The government announced the 23rd licensing round on 20 January 2015. With a particular focus on Barents Sea South-East, which the Storting (parliament) voted to open for petroleum activities in 2013, it represents the first opportunity since 1994 to explore a new area of the NCS. Interest among the companies has been high, with 26 of them submitting applications for acreage to the ministry. New licences have been awarded to 13 companies.

FIGURE 03 **PETROLEUM RESOURCES BY MATURITY AT 31 DEC 2015** (14.2 BN SCM OE)

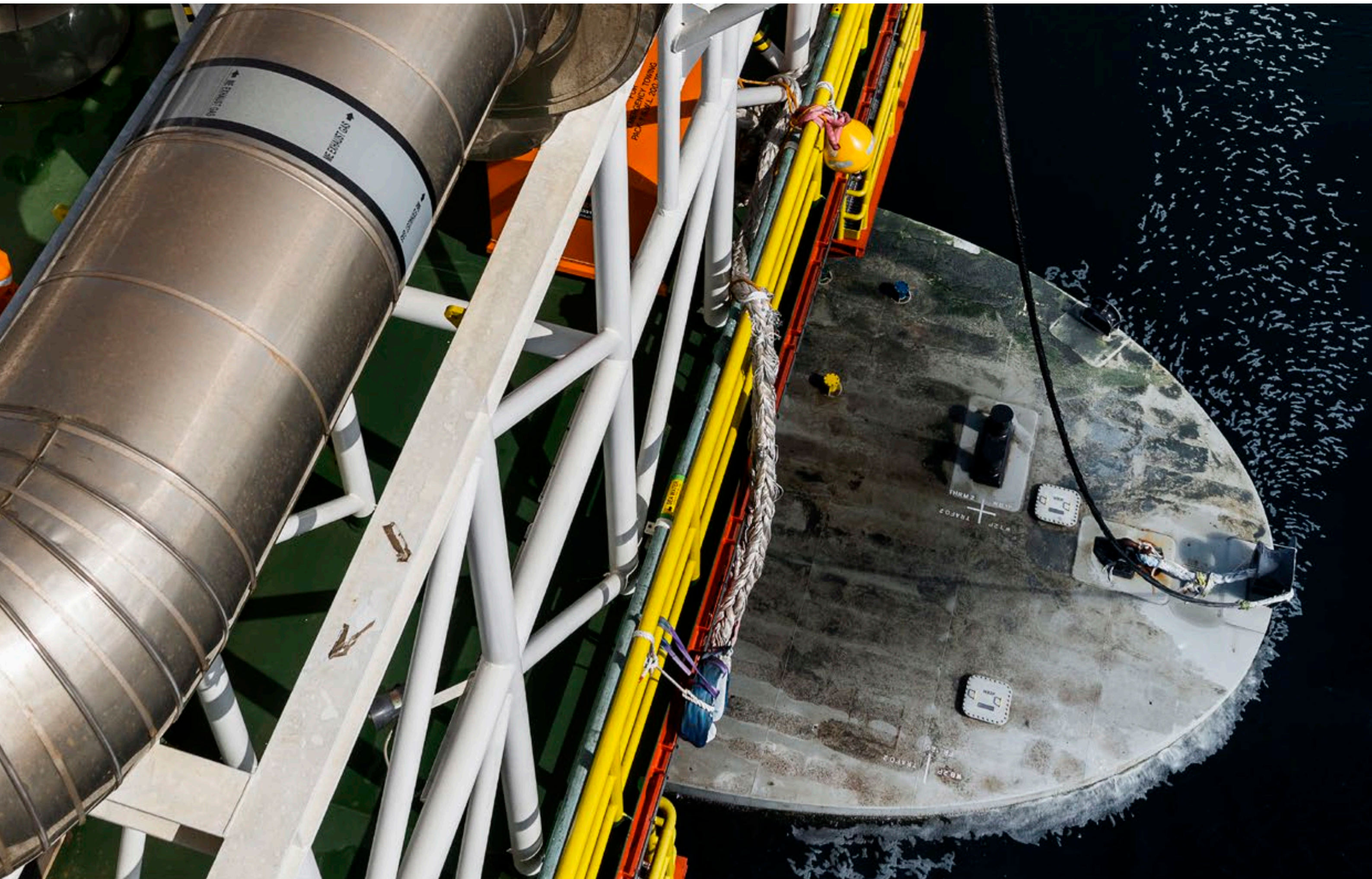
Source: NPD





4 DISCHARGES TO THE SEA

DISCHARGES TO THE SEA DERIVE PRIMARILY FROM DRILLING WELLS AND FROM THE PRODUCED WATER WHICH COMES UP WITH THE OIL. PRODUCED WATER DISCHARGES HAVE LONG BEEN STABLE AT AROUND 130 MILLION SCM PER ANNUM. THEY NEVERTHELESS ROSE TO JUST OVER 140 MILLION SCM IN 2014 AND 148 MILLION SCM IN 2015.



4.1 DISCHARGES FROM DRILLING

Drilling discharges primarily comprise rock particles (drill cuttings) from the borehole and drilling fluid. Discharges are only permitted from wells drilled with water-based fluid, or where contamination from oil-based fluid is less than 10 grams of base oil per kilogram of cuttings. Despite a high level of drilling for both exploration and production wells in 2015, discharges declined from 2014. Even with low oil prices, drilling activity was substantial in 2015. Production wells totalled 188, the largest number since the start of the millennium.

The fluid used when drilling wells has many functions. These include bringing up drill cuttings, lubricating and cooling the drill bit, preventing the borehole from collapsing and, not least, keeping pressure in the well under control to prevent an uncontrolled blowout of oil and gas.

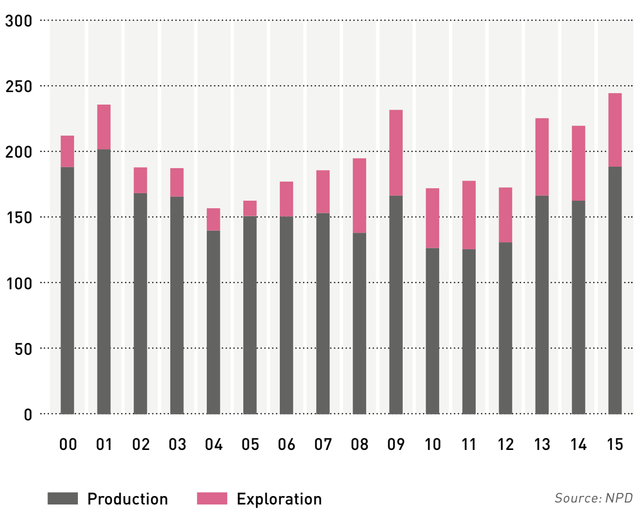
The industry primarily utilises two types of drilling fluids today: oil- and water-based. Ether-, ester- or olefin-based "synthetic" fluids were also utilised earlier, but have been little used in recent years.

Discharging oil-based or synthetic drilling fluids, or cuttings contaminated with these, is prohibited if the oil concentration exceeds one per cent by weight – in other words, 10 grams of oil per kilogram of cuttings. Spent oil-based drilling fluids and contaminated cuttings are either shipped ashore as hazardous waste for acceptable treatment or injected in dedicated wells beneath the seabed.

Consumption of oil-based drilling fluid was markedly higher in 2015 than the year before. The proportion injected declined slightly, while that sent ashore rose correspondingly. A thermomechanical cuttings cleaner (TCC) technology for dealing with oil-contaminated cuttings was adopted on one offshore platform in 2015. In that context, 9.4 tonnes of oil-based fluid was discharged as contamination on 2 460 tonnes of cuttings. Aquateam conducted laboratory tests in 2014 on cuttings with either water-based fluid or treated oil-based fluid in order to qualify TCC for use on the NCS. The results indicate that the two types of cuttings can be expected to have a comparable effect on the environment. This technology was qualified for use on the Martin Linge field in the North Sea as a pilot project. Based on these trials and other documentation, the NEA approved the use of TCC under stringent conditions.

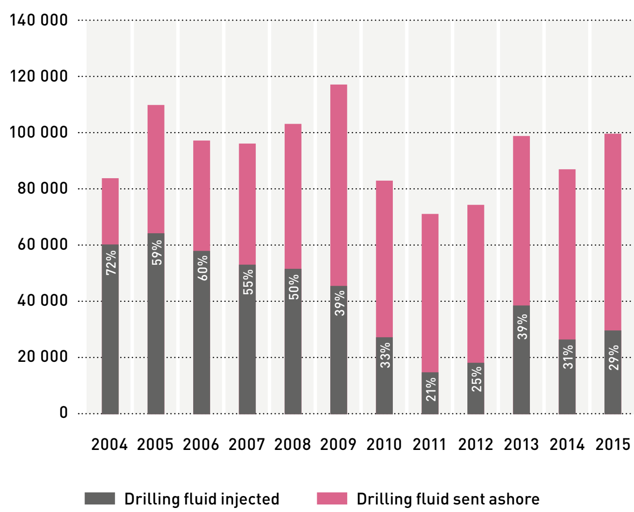
According to the regulations, contamination with base oil cannot exceed one per cent on cuttings to be discharged to the sea. The NEA's permit specified a much stricter limit of 0.05 per cent base-oil contamination for cuttings to be discharged after TCC treatment. Results from utilising the technology varied somewhat during 2015.

FIGURE 04 **WELLS DRILLED ON THE NCS BY PRODUCTION AND EXPLORATION**



Source: NPD

FIGURE 05 **DISPOSAL OF OIL-BASED DRILLING FLUID** (TONNES)



Base-oil contamination of treated cuttings was 0.38 per cent over the whole period. That exceeded the 0.05 per cent limit, but was well below the regulatory ceiling of one per cent.

The operator was subject to stringent conditions for monitoring the natural environment in order to identify possible effects associated with the discharge of TCC-treated cuttings. These requirements covered both environmental monitoring of the water column and seabed surveys as well as impact assessments through toxicity and mesocosm studies.

Water-column monitoring was conducted with mussels from 8 May to 26 June. Analysis results found no significant biological effects from exposure to cuttings treated for base-oil contamination in the sea at distances between 50 and 400 metres from the field. The mussels were confirmed to have been exposed to treated cuttings and had accumulated barium.

Results from the sedimentary investigation showed an increase in the total hydrocarbon content (THC) at all the stations closest to the field centre (a distance of 250 metres) and 500 metres north of it. In other words, the content was above the limit of significant contamination (LSC) used in 2013 (nine mg/kg dry weight). Although a THC increase was measured at these stations, no clear signs were found that the fauna around the field centre had been disturbed.

A new sedimentary survey is scheduled for May 2016 as part of the normal triennial monitoring programme for the field. No indications have so far been found that discharging the treated cuttings has a greater environmental impact than the release of cuttings from water-based fluid.

Injection of cuttings contaminated with oil-based fluid increased somewhat, from 29 per cent in 2014 to 33 per cent. A number of new fields have established dedicated wells for this purpose, while certain older fields where fracturing and leaks from injection wells were discovered in 2007-09 have not established new ones. Figure 6 shows that treated cuttings discharged in 2015 as described above totalled 2 460 tonnes.

The quantities of cuttings presented above are based on calculations of the rock drilled out. However, the amount recorded as being delivered to land in the form of hazardous waste is substantially larger. This is because the cuttings are slurrified by adding water on many fields so that they can be handled more easily to and from the vessels shipping them to land. Oil-contaminated cuttings delivered as waste totalled less than 50 000 tonnes in 2013, rising to 76 550 in 2014 and almost 106 000 in 2015. Water and cuttings are separated on land, with the former treated and discharged to sea while the latter are subject to further treatment in accordance with the applicable regulations.

Discharges of cuttings drilled out with water-based fluid declined further in 2015 to just under 100 000 tonnes – a reduction of almost 13 per cent. Water-based fluid consists primarily of natural components such as clay or salts, which will be classed as green chemicals in the NEA's classification system. In line with Ospar, they pose little or no risk to the marine environment when discharged. The possible impact of these discharges is followed up by extensive environmental monitoring.

FIGURE 06 DISPOSAL OF DRILL CUTTINGS CONTAMINATED WITH OIL-BASED DRILLING FLUID (TONNES)

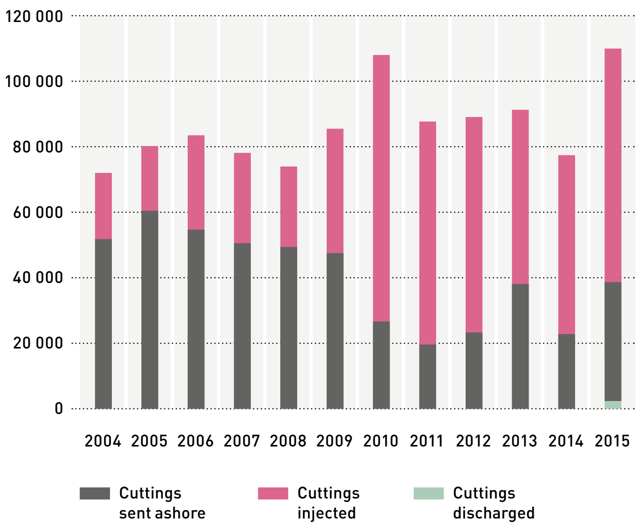
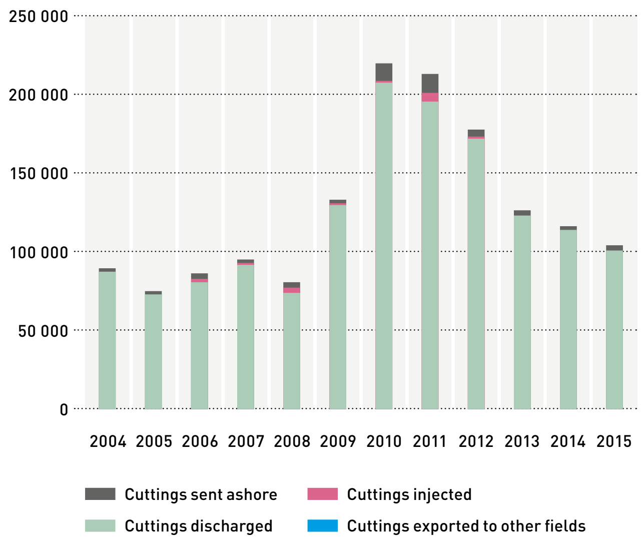


FIGURE 07 DISCHARGE OF DRILL CUTTINGS FROM WELLS DRILLED WITH WATER-BASED FLUID (TONNES)



4.2 DISCHARGES OF OILY WATER

Discharges of oily water from petroleum operations on the NCS derive from three main sources, with produced water accounting for the biggest contribution.

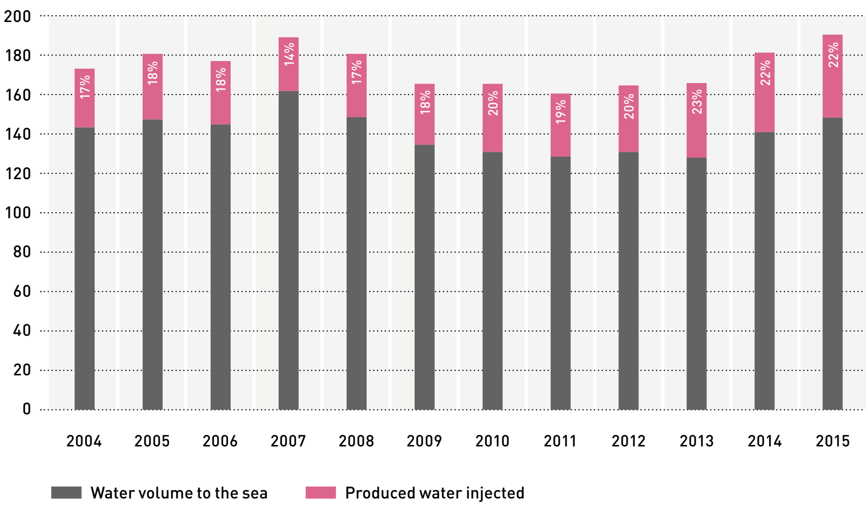
Produced water: This has been in contact with geological formations as well as any oil in these, and accompanies the crude up to the platform where it is treated before being discharged to the sea. The water contains various inorganic salts, heavy metals and organic compounds as well as naturally occurring radioactive substances. Various treatment technologies help to get its oil content as low as possible. The official threshold is 30 milligrams per litre (mg/l).

Displacement water: Seawater is used as ballast in the storage cells on some platforms. When oil is to be stored in the cells, this water must be treated before discharge. The seawater has only a small contact area with the crude, so the quantity of dispersed oil is usually small. The volume discharged depends on the level of oil production.

Drain water: Water falling as rain or used to wash down decks may contain chemical residues and oil. Drain water forms only a small proportion of the total quantity discharged.

Jetting may also form an additional category. Particles and oily sand which accumulate in the separators must be flushed out by water jetting from time to time. Some oil contamination remains on the particles after the water has been treated in accordance with the regulations. The quantity of oily water discharged is marginal.

FIGURE 08 PRODUCED WATER DISCHARGED TO THE SEA OR INJECTED BELOW GROUND (MILL CU.M)



Oily water can also derive from cleaning process equipment, from accidents, or from the deposition of oil droplets released by flaring in connection with well testing and workovers.

PRODUCED WATER DISCHARGES

A continuous rise in discharges of produced water on the NCS was forecast for many years, with the volume expected to exceed 200 million scm in 2012-14. However, this peaked at 160 million cubic metres in 2007 and has declined substantially since. Annual discharges were around 130-140 million cubic metres in recent years, but rose during 2014-15. They amounted to almost 150 million scm in 2015.

On certain fields where conditions are appropriate, all or part of the produced water is injected back into the sub-surface. Such injection rose substantially from 2002, and has been about 20 per cent of the total quantity in recent years. Just over 22 per cent was injected in 2015, or a little more than 44 million scm.

Produced water in new fields consists exclusively of the amount already present in the reservoirs. However, its quantity increases as the field ages because water is injected to maintain reservoir pressure and improve the oil recovery factor. Treated seawater is normally used. Oil recovery factors for fields on the NCS are generally well above the global average. Despite this, discharges on the NCS are comparable with international figures.

The increasing quantity of produced water means that its proportion (cut) of output from the NCS shows a rising tendency, and it came to more than twice the amount of oil in 2015.

Monitoring has not identified any environmental effects from releasing produced water.

DISCHARGES OF OTHER WATER TYPES

Displacement water dominates discharges of other water types. The volume discharged declined steadily up to 2009-11 and has since risen slightly. Sources other than produced water accounted for just over 35 million scm of discharges in 2015.

DISCHARGES OF OILY WATER

Water is treated before discharge with the aid of different technologies on the various fields. The average oil content of produced water for the whole NCS was 12.3 mg/l in 2015, compared with the official requirement of 30 mg/l. That represented a slight decline from the year before.

The quantity of oil in produced water discharged to the sea rose from 1 761 tonnes in 2014 to 1 819 in 2015. See figure 12. A total of 1 925 tonnes of oil was released in water on the whole NCS in 2015. The concentration of dispersed oil increased steadily from 2003 to 2014, but declined somewhat in 2015 to reach 12.3 milligrams per litre of water.

DISCHARGES OF OTHER SUBSTANCES WITH THE WATER

Produced water has been in contact with the sub-surface for a long time, and therefore contains a number of naturally occurring substances. In addition to oil, these typically include monocyclic and polycyclic aromatic hydrocarbons (PAH), alkyl-phenols, heavy metals, natural radio-active materials, organic substances, organic acids, inorganic salts, mineral particles, sulphur and sulphides. Their composition will vary from field to field, depending on sub-surface properties. The content of environmentally hazardous substances is generally low, close to the natural background level in seawater.

FIGURE 09 RATIO BETWEEN PRODUCED WATER AND OIL PRODUCTION ON THE NCS (CU.M)

FIGURE 10 DISCHARGES TO THE SEA OF OTHER OILY WATER TYPES (MILL CU.M)

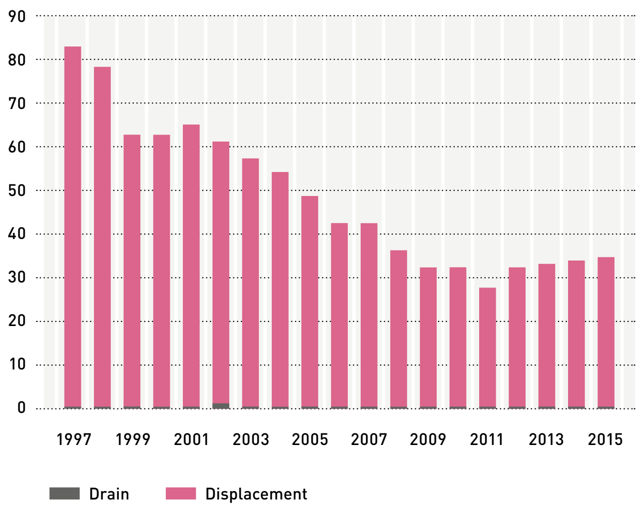


FIGURE 11 OIL CONCENTRATION IN PRODUCED WATER DISCHARGED TO THE SEA (MG/L)

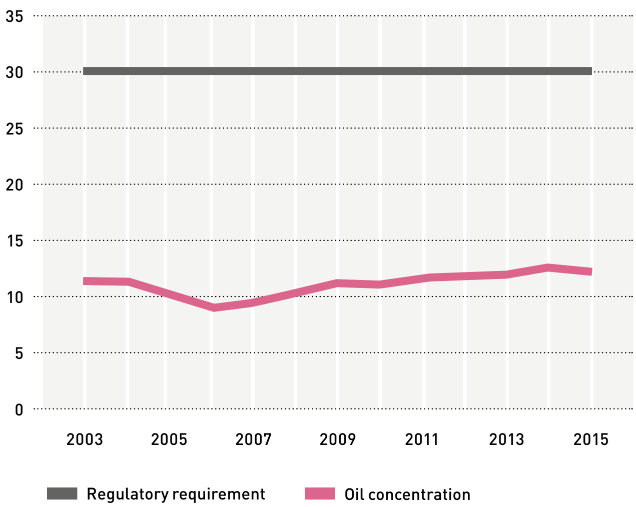
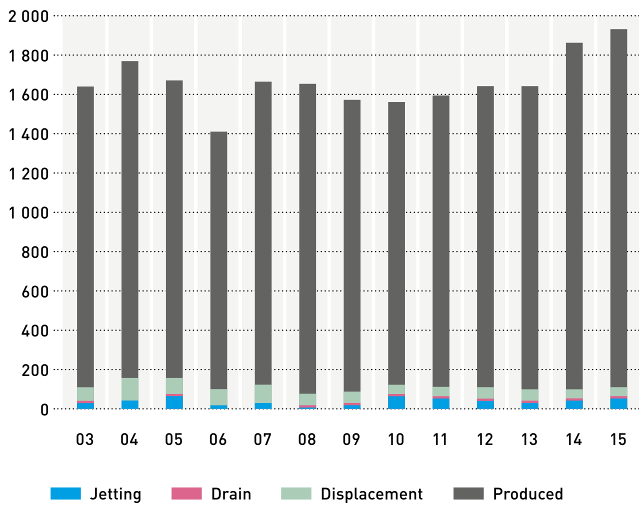


FIGURE 12 OIL CONTENT IN WATER DISCHARGED ON THE NCS (TONNES)



4.3 TREATMENT OF OILY WATER

Work on reducing discharges to zero has led, through injecting water or treating it before discharge, to a substantial decline in the quantity of oil released to the sea. The potential environmental risk related to discharging produced water is assessed for each field through analyses and model calculations, and expressed as the environmental impact factor (EIF). These calculations demonstrate that dispersed oil represents a very small proportion of the risk picture associated with produced water.

Research shows that certain other components found in produced water can have harmful effects on aquatic organisms. However, this relates to concentrations only found close to the release point – within a distance of a few hundred metres. Water-column monitoring on the NCS confirms that no negative effects can be demonstrated for the discharges beyond the immediate vicinity. See chapter 5.

Substantial investment has been made in treatment technology and injection in order to reduce oil discharged with produced water. On some fields, several billion kroner have been spent on treatment solutions for oily water. Running such facilities also costs from a few to several tens of millions of kroner per annum. New treatment technology and improved operation have reduced the concentration of oil in produced water on a number of fields. While most fields have discharges far below the official ceiling of 30 mg/l, some experience problems for various reasons in achieving stable operation of injection facilities and treatment processes.

On behalf of Norwegian Oil and Gas, DNV GL has reviewed discharge data and treatment technologies on the NCS. Its findings emphasise facts which have also been reported earlier by the environmental authorities.

- A good treatment effect can be achieved on one field with simple techniques, while others face more challenging conditions and require additional measures. Even when the latter are implemented, variations in conditions can lead to big fluctuations in the treatment effect.
- Different treatment techniques have limitations related to operational conditions, including oil type, water quality and volume, pressure changes, use of chemicals, phasing in wellstreams from other fields and so forth.
- A technique which works well in one location can accordingly be less suitable or inappropriate elsewhere.
- The success of treatment can fluctuate substantially over time – from one month to another and from year to year – as a result of operating conditions.

This underlines the importance of the work done when choosing a solution for the individual field on the basis of best available technology (BAT). Ensuring cost-adapted environmental solutions, such BAT assessments extend far beyond simply looking at dispersed oil in water (which is the focus for this study). Energy consumption and cost are other key subjects, for example. Where new fields on the NCS are concerned, injection is assessed as a possible strategy for handling produced water. This approach has been adopted on many fields, and the latest forecasts from the NPD indicate that the volume of produced water discharged will decline.

Efforts to acheive zero discharges on the NCS are rooted in a risk-based approach. This uses risk assessments in order to apply measures where they have the biggest environmental effect while striking a sensible balance between cost and benefit.

4.4 CHEMICAL DISCHARGES

Chemicals are assessed on the basis of their environmental properties, including persistence, bioaccumulative ability and toxicity (PBT). The Norwegian government has also specified criteria in the activities regulations and in guidelines for reporting from offshore petroleum operations.

A dedicated flow diagram has been developed for environmentally hazardous substances to determine the category they should be reported in. See table 1. Chemical additives are divided by the NEA into four categories (green, yellow, red and black) in accordance with the classification in the activities regulations.

1) GREEN Chemicals considered to have no or very limited environmental impact. Can be discharged without special conditions.

2) YELLOW Chemicals in use, but not covered by any of the other categories. Can normally be discharged without specified conditions.

3) RED Chemicals which must be given priority for substitution, but which can be discharged with government permission.

4) BLACK Chemicals which the government can permit to be discharged in special circumstance – where this is crucial for safety, for instance.

Discharges of chemical additives from Norwegian petroleum operations totalled just over 157 000 tonnes in 2015, a slight decline from the year before. Green chemicals accounted for almost 91 per cent of this figure, while the red and black categories contributed 67 and 6.6 tonnes respectively. They thereby accounted jointly for some 0.046 per cent of discharges. Yellow chemicals represented 9.2 per cent.

Replacing chemicals with less environmentally harmful alternatives – known as the substitution duty – represents an important part of efforts to reduce possible environmental effects from offshore discharges. Extensive substitution of chemicals has reduced the release of the most environmentally harmful substances to a fraction of what it was only 10 years ago. Operators regularly assess the chemicals used to see if they can be substituted.

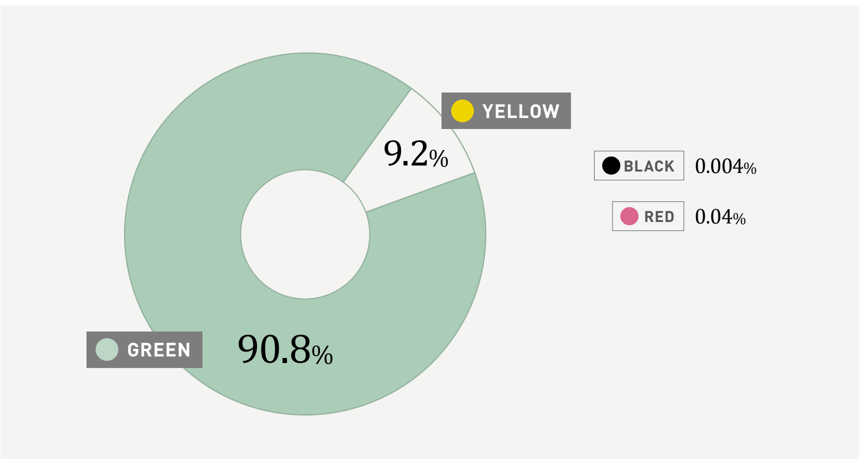
However, a marked increase in reported discharges of black and to some extent red chemicals occurred in 2011-14. This trend appears to have been reversed in 2015 with regard to black substances.

Discharges of the latter came to 6.6 tonnes in 2015, down from 13.9 tonnes the year before. Where the red category is concerned, discharges rose from 14.3 tonnes in 2014 to 67 tonnes.

Complex factors underlie the variations in recent years, but changed requirements for reporting and for substitution work are the most important. Discharges of fire extinguishing foam were not reported earlier because this was a safety chemical with no alternative products able to offer satisfactory extinguishing properties. It was accordingly exempted from the substitution and reporting duties. See the HSE regulations. Alternatives to certain foams with less environmentally harmful properties are now available. These are now being phased in, but it will be several years before all fields on the NCS have replaced the old types with new versions.

Mandatory exercises and tests will accordingly lead to discharges of black chemicals for a number of years to come. The new alternatives still contain components categorised as red. That explains the marked increase in discharges for this category of chemicals.

FIGURE 13 **BREAKDOWN OF DISCHARGES OF CHEMICAL ADDITIVES FROM THE NCS BY THE NEA'S CATEGORIES** (2015)



TABLE

01 THE NEA'S TABLE FOR CLASSIFYING AND REPORTING CHEMICALS

Discharge	Category[1]	NEA colour category
Water		
Substances on Ospar's Plonor list	201	Green
Substances covered by Reach annex IV [2]	204	Green
Certain substances covered by Reach annex V [3]	205	Green
Substances with no test data	0	Black
Substances thought to be, or which are, hazardous to genes or reproduction [4]	1.1	Black
List of prioritised substances in result objective 1 (priority list)	2	Black
Biodegradability < 20% and log Pow ≥ 5 [5, 4]	3	Black
Biodegradability < 20% and toxicity EC_{50} or LC_{50} ≤ 10 mg/l [4]	4	Black
Two out of three categories: biodegradability < 60%, log Pow ≥ 3, EC_{50} or LC_{50} ≤ 10 mg/l	6	Red
Inorganic and EC_{50} or LC_{50} ≤ 1 mg/l	7	Red
Biodegradability < 20% [4]	8	Red

Discharge	Kategori[1]	NEA colour category
Substances in yellow category:		
Substances with biodegradability > 60%	100	Yellow
Substances with biodegradability 20-60%		
Sub-category 1: expected to biodegrade fully	101	Yellow
Sub-category 2: expected to biodegrade to environmentally non-hazardous substances	102	Yellow
Sub-category 3: expected to biodegrade to substances which could be environmentally hazardous	103	Yellow

[1] A description of the category is provided in the flow diagram. Category in table 5-1 has been related to category in table 6-1 to ensure correspondence with reported figures in the two tables.

[2] Removed from the black category in the activities regulations.

[3] Substances hazardous to genes or reproduction are understood to mean mutagen categories (Mut) 1 and 2 and reproduction categories (Rep) 1 and 2, see appendix 1 to the regulations on labelling, etc, of hazardous chemicals or self-classification.

[4] Data for degradability and bio-accumulation must accord with approved tests for offshore chemicals.

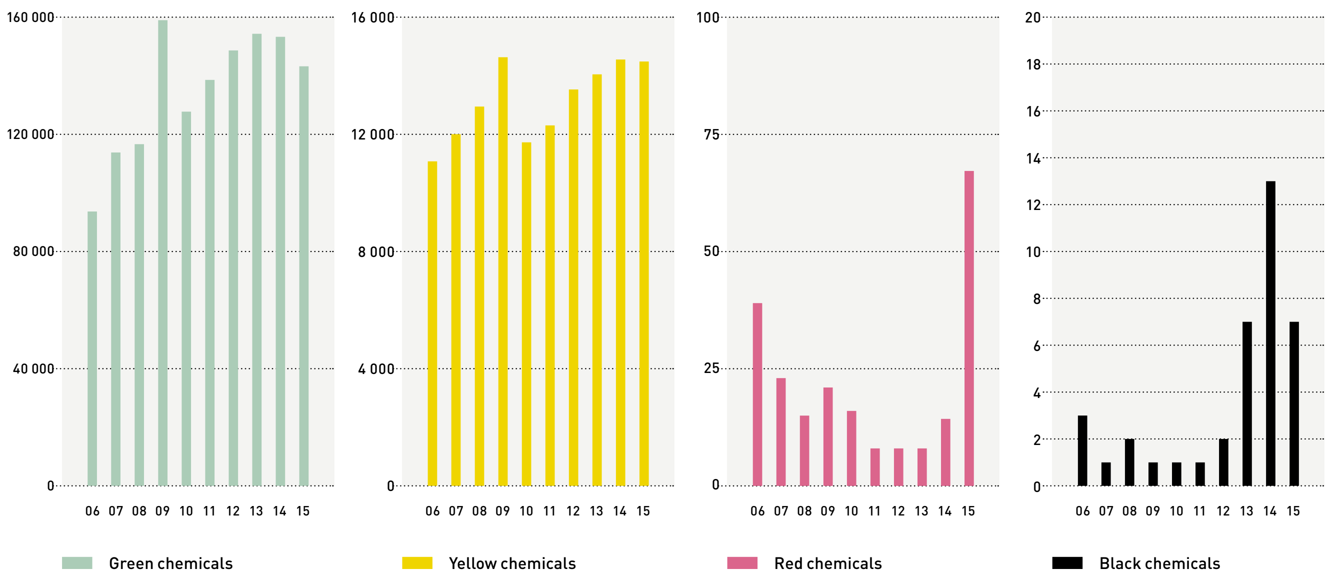
[5] Removed from the red category in the activities regulations.

[6] Commission regulation 987/2008. The NEA must assess whether the substance is covered by annex V.

- Grønn: Chemicals considered to have no or very limited environmental impact. Can be discharged without special conditions.
- Gul: Chemicals in use, but not covered by any of the other categories. Can normally be discharged without specified conditions.
- Rød: Chemicals which must be given priority for substitution, but which can be discharged with government permission.
- Svart: Chemicals which the government can permit to be discharged in special circumstance – where this is crucial for safety, for instance.

FIGURE

14 DISCHARGES OF CHEMICAL ADDITIVES FROM THE NCS BY THE NEA'S CATEGORIES (TONNES)



4.5 UNINTENTIONAL SPILLS

Unintentional spills are defined as unplanned emissions/discharges which occur suddenly and are not covered by a permit. Possible environmental consequences of such releases will depend on the properties and quantity of the substance emitted/spilt, and when and where the incident occurred.

Unintentional spills are classified in three principal categories:

- oil: diesel, heating, crude, waste and others
- chemicals and drilling fluid
- emissions to the air.

Norway's oil and gas industry pays great attention to adopting measures to reduce incidents which cause unintentional spills. All spills down to less than a litre are reported to the NEA in the annual emission/discharge reports.

OIL SPILLS

Unintentional oil spills have generally declined in number throughout the reporting period, but show a clear downward trend over the past eight-nine years. Forty-seven such incidents occurred in 2015, compared with 59 the year before. Spills larger than 50 litres have become steadily less frequent since 1997. There were 23 of these in 2015, unchanged from the year before, with 17 in the range from 50 litres to one cubic metre and six larger than one cubic metre.

A similar long-term decline can be observed for crude oil spills alone. There were 19 of these in 2015, including eight smaller than 0.05 cubic metres, eight in the range from 0.05 to one cubic metre and three in the largest category, above one cubic metre.

The total volume of oil unintentionally spilt varies substantially from year to year, with the statistics affected by large single incidents. Totalling more than 4 000 cubic metres, the second largest oil spill on the NCS occurred in 2007. The combined volume in 2015 was 40 cubic metres.

UNINTENTIONAL CHEMICAL SPILLS

No similar declining trend can be seen for unintentional chemical spills. These have lain around 150-160 incidents annually over the past five years, but rose substantially in 2014 to 237. Most of this increase occurred in the size category below 50 litres, where the number doubled as a result of clarifications to the regulations. Spills fell back to just over 170 in 2015.

Unintentional chemical spills had an overall volume of 1 580 cubic metres in 2015, including 1 495 tonnes of green chemicals, 253 tonnes of yellow, just under 10 tonnes of red and 3.9 tonnes of black.

Discharged volumes were dominated in 2007-10 by individual years when leaks from injection wells were discovered. These are now shut in. The biggest spill in 2015 involved leaks of 665 cubic metres from a blowout preventer (BOP), including 548 cubic metres in the form of water while green and yellow chemicals accounted for 10 and five per cent respectively. Totalling 228 cubic metres, the second largest spill comprised oil-based drilling fluid where black and red chemicals accounted for less than one per cent.

FIGURE 15 UNINTENTIONAL OIL SPILLS TO THE SEA ON THE NCS

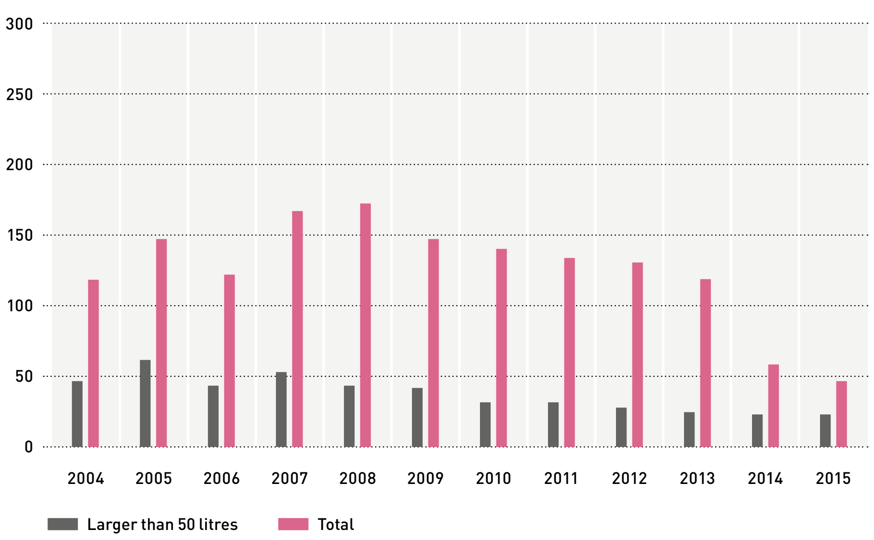


FIGURE 16 UNINTENTIONAL CRUDE OIL SPILLS TO THE SEA ON THE NCS

FIGURE 17 VOLUME OF UNINTENTIONAL OIL SPILLS ON THE NCS (CU.M)

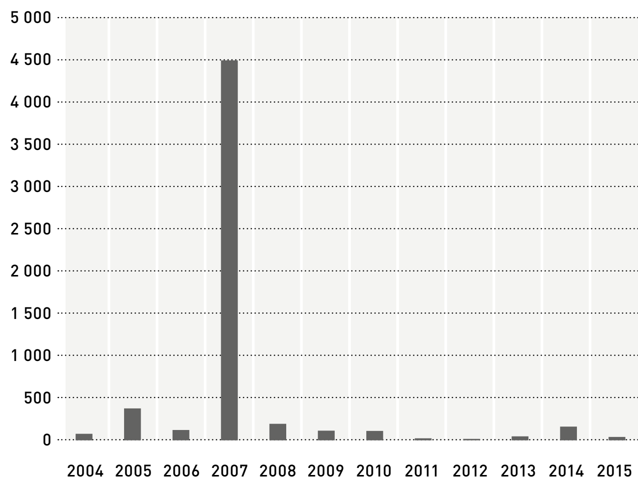


FIGURE 18 UNINTENTIONAL CHEMICAL SPILLS ON THE NCS BY THREE SIZES OF SPILL

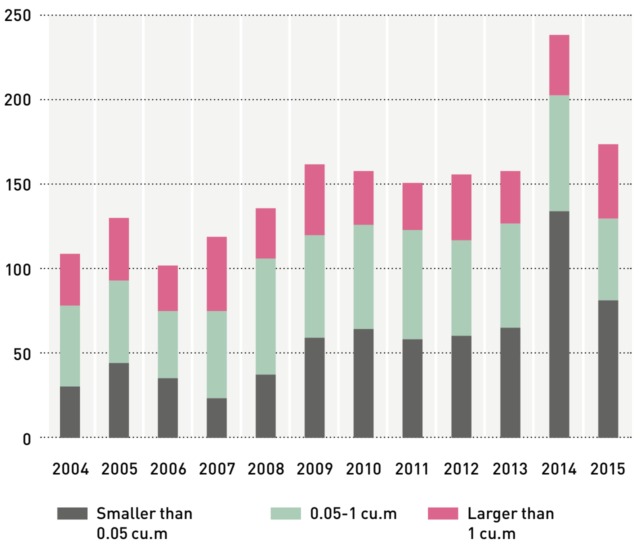
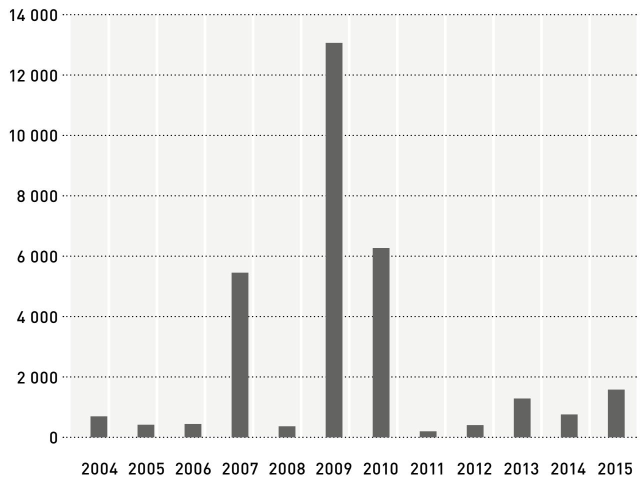


FIGURE 19 TOTAL VOLUME OF UNINTENTIONAL CHEMICAL SPILLS (CU.M)



5 OFFSHORE OPERATIONS AND THE MARINE ENVIRONMENT

MONITORING OF THE MARINE ENVIRONMENT IS INTENDED TO PROVIDE AN OVERVIEW OF ITS CONDITION AND DEVELOPMENT OVER TIME. SUCH SURVEILLANCE IN THE PETROLEUM INDUSTRY COVERS INVESTIGATIONS OF THE WATER COLUMN AND BENTHIC HABITATS (SEDIMENTARY, SOFT SEABED AND HARD SEABED FAUNA).

The oil and gas industry conducts extensive environmental monitoring of the NCS on an annual basis. Almost 40 years of such surveillance has created a unique database of environmental information. Substantial research work related to the development of monitoring methods and to understanding the impact of petroleum industry discharges on the marine environment is being pursued by individual companies as well as through appropriations from Norwegian Oil and Gas.

Monitoring is conducted in accordance with standards described in the NEA's guidelines. These are a result of collaboration between the NEA, its panel of experts, the petroleum industry and the consultants doing the work. The most recent guidelines were published in 2015.[1] They specify in detail which parameters should be analysed, which methods should be used, necessary accreditation of laboratories and consultants, and templates for reporting. Monitoring is conducted by independent consultants, whose work is reviewed and quality-assured by a panel of experts on behalf of the NEA.

Such surveillance covers investigations of the water column and benthic sediments and fauna, as well as visual inspection of the seabed in areas where species assumed to be particularly vulnerable to discharges (corals, sponges and so forth) are present. Extensive changes to procedures for water column monitoring have been made by the NEA. The recommended approach is now to conduct a large-scale survey every three years, rather than smaller annual inspections. Surveillance will continue to be based on investigating organisms in cages and wild-caught fish, but the terms "impact monitoring" and "condition monitoring" are no longer used. This approach will also provide better time for further development of methods in the intervening periods.

WATER-COLUMN MONITORING

Produced water discharged to the sea contains chemical compounds which could be toxic for marine organisms. Fish and mussels positioned in cages at increasing distances from the installations are among the methods which have been used to describe the possible effects of discharges to the water column. With effect from 2015, a major water-column survey is required every third year starting in 2017. No water-column monitoring was conducted in 2015.

Discharges of produced water totalled about 148 million cubic metres in 2015, up by about five per cent from the year before. Just over 1 800 tonnes of dispersed oil in produced water were discharged during 2015.

The volume of the North Sea is no less than 94 000 cubic kilometres, or 94 billion cubic metres. This is a dynamic sea area characterised by a big throughflow of water. The inflow totals about 1.5 million cubic metres per second. From that perspective, the volume of produced water discharged annually compares with about 90 seconds of seawater flowing into the North Sea from adjacent sea areas. Retention time for this water is relatively short, with its replacement taking about a year overall but as little as months or weeks depending on the area concerned. Produced water is rapidly diluted by ocean currents after discharge from the platforms. This has been verified by water column monitoring.

A panel of experts reviewed and collated various monitoring techniques and effects identified by the surveillance work. They concluded that theoretically possible toxic concentrations extend no more than 1 000-2 000 metres from the release point, and that significant biological effects are limited to a distance of less than 1 000 metres.

SEDIMENT MONITORING – SEABED INVESTIGATIONS

The NCS is divided into 11 geographic regions for seabed monitoring, and the scale of this work must be related to offshore petroleum activities in each region.

An investigation must be conducted with all fields before they come on stream to establish the base condition before starting to discharge drill cuttings. Each region and field is then investigated every third year to establish the physical, chemical and biological status of the sediments. Benthic habitat monitoring involves sampling the seabed, analysing sediments for heavy metals and oil compounds, and investigating biodiversity in the benthic fauna.

Monitoring the environmental condition of seabed sediments around Norwegian offshore installations has been under way since the late 1970s. Field-based surveys were conducted annually until 1996. Thereafter, monitoring around individual fields was incorporated in regional programmes which have been pursued until the present day.

This work is done by independent accredited consultants, and detailed guidelines

[1] http://www.miljodirektoratet.no/no/Publikasjoner/2015/Januar1/Miljoovervaking-av-petroleumsvirksomheten-til-havs/).

ensure that results from different surveys are comparable across time and space. The results are assessed by the government's panel of experts and made available in the joint MOD database operated by Norwegian Oil and Gas, which is open to the general public and to researchers. The monitoring programme is among the most extensive conducted regularly on the North Atlantic seabed, and covers an estimated 1 000 stations on the NCS. Of these, about 700 are in the North Sea. Once the production phase has ceased, two further rounds of investigations are conducted at three-year intervals. The MOD is to be modernised and transferred to an improved software platform in 2016. It will also exchange information with the Norwegian Maritime Data Centre (NMDC), which has a large number of partners (www.nmdc.no).

The government and its panel of experts make comments on the reports submitted. Updated reports will be published in the autumn of 2016. The final results from environmental monitoring in 2015 will become available in October 2016.

REGION II – SLEIPNER AREA

Preliminary findings from the surveys.

- They covered 25 fields and installations as well as 15 regional stations in the area between 58-60°N, including Sleipner, Jotun, Alvheim and Johan Sverdrup. The region incorporates a total of 284 stations.
- The survey took place from 19 May-1 June 2015.
- Water depths varied from 74-130 metres, with the sediments characterised as fine/very fine sand.
- The THC varied from four-five mg/l in the northern sub-region, from less than 1-10 mg/kg in the shallow sub-region, and from 1-176 mg/l for the central sub-region (with the exception of extreme values for a station on Ringhorne (RIN34) which smelt of petroleum products).
- Faunal composition at the regional stations in each sub-region is relatively stable from year to year, but the number of species and density of individuals varies substantially. Soft-bottom fauna consist primarily of bristle worms, crustaceans, mussels and echinoderms. Faunal composition can be related to the natural variation in such environmental parameters as depth and sediment type, and to pollution parameters like metal and hydrocarbon content in the sediment.
- Benthic fauna are regarded as disturbed at two stations – one on Ringhorne and the other near Bøyla.
- The acreage with a THC higher than 50 mg/kg (regarded as the threshold for faunal effects) is estimated at 1.1 square kilometres.

REGION VI – HALTEN BANK

Preliminary conclusions from the region.

- Region VI covers 19 fields, including Draugen, Heidrun, Norne and Skarve, as well as 14 regional stations. Sediment and faunal samples were acquired from 305 stations in all. The survey took place from 19 May to 8 June 2015.
- Water depths across the region vary from 240-413 metres. Petroleum operations have been under way since 1993 (Draugen).
- Sediments in the region are dominated by pelite (particles with diameters greater than 0.063 millimetres) in proportions from 45-93 per cent as well as some fine sand.
- The THC in the sediments at the regional stations was low, ranging from 1.8-6.7 mg/kg. The overall area with a THC above 50 mg/kg declined from 3.3 square kilometres in 2012 to 0.4 in 2015. Where fields are concerned, concentrations above 50 mg/kg were found in 2012 at individual stations on Tyrihans, Skarv and Idun and one station on Marulk. The maximum THC for these fields in 2015 was below 50 mg/kg.
- Faunal composition showed a total of 1 218 899 individuals divided between 607 taxa at the 216 stations in the region. Bristle worms and molluscs. Region VI fauna were calculated to be disturbed in an area of 0.37 square kilometres (confined to Njord), a reduction from the previous survey.

DEEPWATER PROGRAMME IN 2015

Environmental monitoring in deep water on Ormen Lange and a base investigation on Aasta Hansteen were conducted in 2015 with the aid of a video-assisted multi sampler (Vams). This makes sampling more effective because several grab samples can be taken at the same time in waters more than 500 metres deep. The Norwegian Institute of Marine Research reports that an environmental survey was conducted at a depth of 1 400 metres in a 10th of the time required with a simple van Veen grab. Vams can also be equipped with other measurement devices and sondes to check such parameters as conductivity, temperature and depth, and to take images. Benthic sampling can be conducted without problems by inspecting the area with a remotely operated vehicle (ROV) before grab samples are taken.

VISUAL INSPECTIONS

Visual inspections are carried out before planned exploration drilling can begin in areas which may contain organisms regarded, on the basis of the precautionary principle, as particularly vulnerable to drilling discharges. The industry has developed guidelines for such surveys where deepwater corals are present. At the same time, substantial work is being devoted to developing methods and procedures for preliminary investigations to avoid physical damage to coral reefs, sponge communities and the like. The Norwegian Institute of Marine Research has concluded that no harm to coral reefs from petroleum activities has ever been demonstrated. This work is now being extended to cover sponge communities and various sponge species. Comparative studies of the methods used by the industry and in the big Mareano project have also been conducted to ensure comparable results.

Following drilling activity in 2009-12, the Hyme and Morvin fields were visually inspected during 2015 in order to identify possible effects from the associated discharges.

HYME

Drilling took place in April-June 2012. The 2015 investigations aimed to check possible long-term effects of discharges from this activity. Field work was conducted on 24-25 April using an Argus medium working-class ROV with sonar.

- The diversity of megafauna on Hyme is relatively high, with many species and individuals. Crustaceans are abundant, particularly squat lobsters (*Munida sp*) but also stone crabs and various prawns (*Crangon* and *Pandalus*). Norway lobsters (*Nephrops norvegicus*) and scattered communities of deep-water sponges have been observed. Corals and sponge communities like those around Hyme often support such fish species as redfish, tusk and ling. Cod and saithe circled the ROV while searching for food in the illumination from the searchlights.
- No reduction in corals since 2013 was observed. Various fauna were present in numbers comparable with earlier surveys.
- The template has led to an increase in the sessile fauna.
- Drill cuttings discharged during the drilling campaign have been colonised by crustaceans and other benthic fauna.
- Visual surveys were conducted by ROV and high-resolution cameras.

MORVIN

The water depth on the field is about 380 metres. Drilling was conducted in 2009-11, with cuttings transported to a discharge site about 4 000 metres east of the well to avoid conflict with such species as *Lophelia*. The survey was conducted from 21-25 April. Visual observations were made using an Argus medium working-class ROV with sonar. Other species, such as *Paragorgea*, were also registered.

- Visual inspection covered about 1 600 metres of the seabed.
- 88 coral reefs were registered.
- No signs of disturbance or smothering were found.

6 EMISSIONS TO THE AIR

POWER GENERATION FUELLED BY NATURAL GAS OR DIESEL OIL IS THE MAIN SOURCE OF CO_2 AND NO_X EMISSIONS. ENHANCED ENERGY EFFICIENCY DURING PRODUCTION MEANS THAT SUCH EMISSIONS FROM THE NCS ARE ONLY 44 PER CENT OF THE WORLD AVERAGE.

6.1 EMISSION SOURCES

Emissions to the air from the oil and gas industry consist primarily of exhaust gases containing CO_2, NO_x, SO_x, CH_4 and nmVOC from different types of combustion equipment. In most cases, emissions to the air are calculated from the amount of fuel gas and diesel oil used on the facility. The emission factors build on measurements from suppliers, standard figures produced by the industry itself, or field-specific measurements and calculations.

The main sources of emissions to the air from oil and gas activities are:

- fuel gas exhaust from gas turbines, engines and boilers
- diesel exhaust from gas turbines, engines and boilers
- gas flaring
- combustion of oil and gas in connection with well testing and well maintenance

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

- gas venting, minor leaks and diffuse emissions
- vaporisation of hydrocarbon gases from offshore storage and loading of crude oil

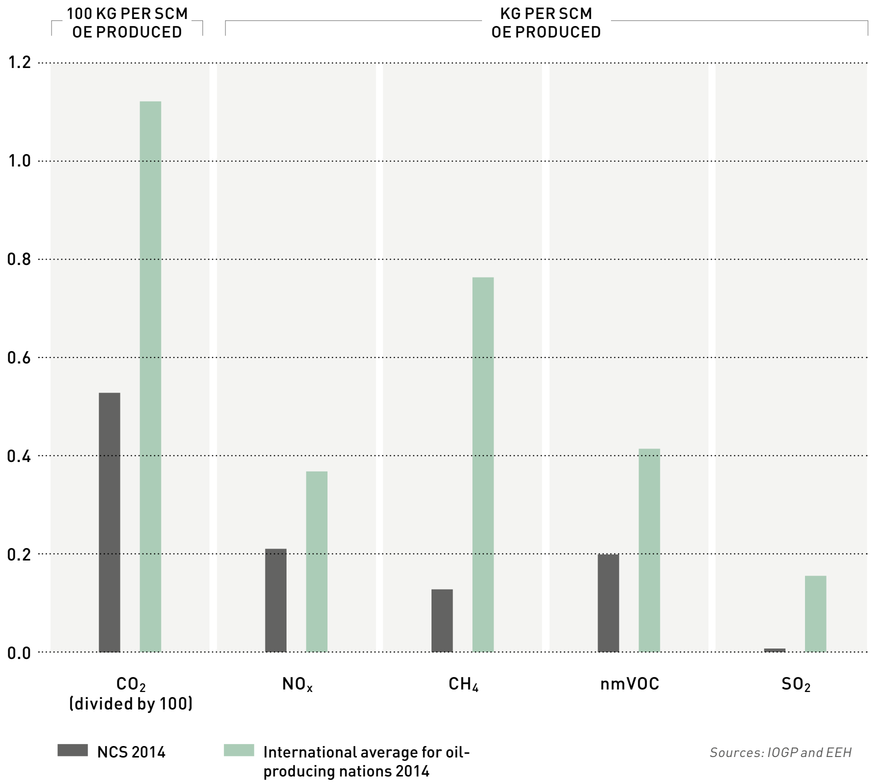
Power generation using natural gas and diesel oil as fuel is the main source of CO_2 and NO_x emissions. Their level depends mainly on energy consumption by the facilities and the energy efficiency of power generation. Gas flaring is the second largest source of this emission type. It only takes place to a limited extent, pursuant to the provisions of the Petroleum Act, but is permitted for safety reasons during operation and in connection with certain operational problems.

The most important sources of CH_4 and nmVOC emissions are offshore storage and loading of crude oil. During tank filling, volatile hydrocarbons vaporise into the tank atmosphere and mix with the inert gas added for safety reasons to eliminate the risk of explosion. Emissions occur as this mix is vented to the air when displaced by the entry of crude oil.

SO_x emissions derive primarily from the combustion of sulphur-containing hydrocarbons. Since Norwegian gas is generally low in sulphur, diesel oil is the principal source of such emissions on the NCS. Low-sulphur diesel oil is accordingly used.

Figure 20 presents emissions to the air on the NCS compared with international averages, specified per scm oe produced in 100 kilograms for CO_2 and in kilograms for the other substances. All figures are from 2014 because international figures for 2015 were not available in June 2016.

FIGURE 20 EMISSIONS TO THE AIR ON THE NCS COMPARED WITH THE INTERNATIONAL AVERAGE



Sources: IOGP and EEH

6.2 EMISSIONS OF GREENHOUSE GASES

Global warming is one of the biggest challenges of the age, and sharp reductions in anthropogenic GHG emissions are essential to avoid the worst consequences.

Ambitious goals were adopted at the UN's COP21 climate summit in Paris. A total of 195 countries will sign this pact. All parties to the Paris agreement have been requested to ratify it – in other words, undertake to abide by its terms – no later than April 2017. The convention will come into effect when it has been ratified by 55 countries accounting for 55 per cent of GHG emissions.

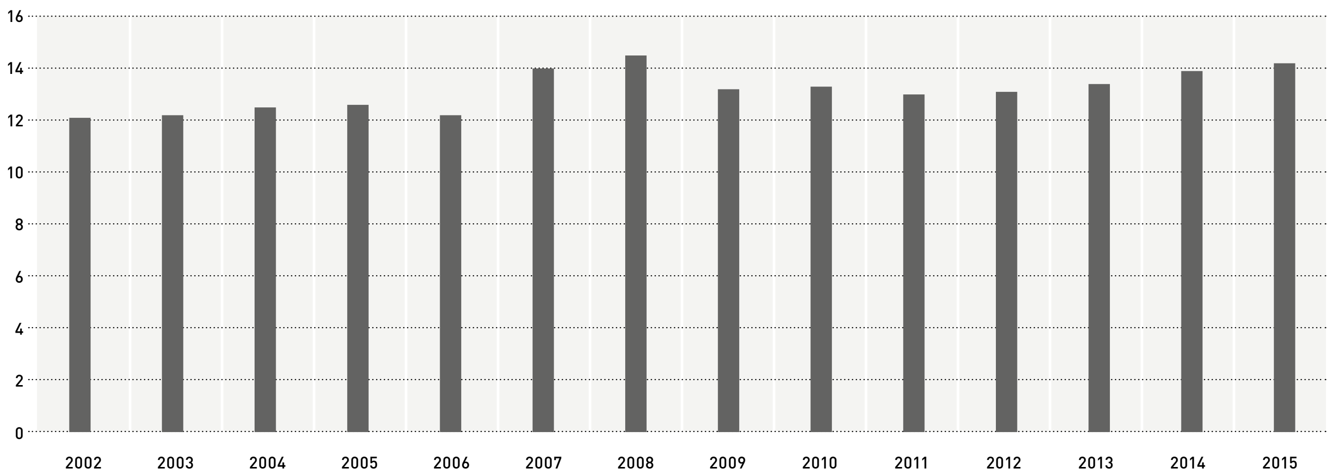
Once this agreement is in force, each country's intended nationally determined contributions (INDCs) will no longer be regarded as indicative but as that nation's official climate plans. A status report is to be prepared every five years to assess these goals, when it will only be possible to maintain or increase the national ambitions.

The overall goal of the climate convention is to stabilise GHG concentrations in the atmosphere at a level where the most serious anthropogenic climate changes can be avoided. While the aim of keeping the average rise in global temperatures below 2°C still applies, an ambition of trying to limit this increase to 1.5°C was also adopted. In addition, COP21 resolved that anthropogenic GHG emissions should not be higher in 2050-2100 than can be absorbed by nature and by carbon capture and storage (CCS). That means zero net emissions, and will provide the framework for the low-emission society of the future.

A commitment to reduce GHG emissions in 2030 by at least 40 per cent compared with 1990 has been made by the EU. The most important instrument for achieving this is the EU's emission trading system (ETS). Roughly half of Norway's GHG emissions are subject to the ETS, including those from land-based industry and aviation as well as the petroleum sector. Emission allowances will be cut step-by-step towards a reduction target for 2030 of 43 per cent in the sectors subject to the ETS compared with 2005.

Emission reduction goals set by Norway are similar to the EU's, and the government is working now to secure a bilateral agreement with the EU on joint fulfilment of their climate commitments by 2030.

FIGURE 21 EMISSIONS OF CO_2 EQUIVALENT ON THE NCS (MILL TONNES)



WHAT IS THE PETROLEUM SECTOR DOING TO CUT ITS EMISSIONS?

Every sector must contribute to emission reductions if the target is to be reached. Continuous efforts are being made by the petroleum sector on the NCS to cut its emissions, and a number of processes have been initiated to reinforce this work.

The industry is currently preparing a road map which will define ambitions for reducing its own emissions from oil and gas production.

This road map for the NCS is being drawn up by Norwegian Oil and Gas and the Federation of Norwegian Industries, together with the Norwegian Confederation of Trade Unions (LO) and the Norwegian Shipowners Association through KonKraft. The latter is a collaboration arena for these four organisations.

An action plan will also be included in the road map to specify how the companies are to follow up the necessary technology development and the work of identifying and implementing measures to reduce GHG emissions.

A work group chaired by Norwegian Oil and Gas was established in the autumn of 2014 to update the 2007 KonKraft report on the petroleum industry and climate issues. This group will look at technological and industrial opportunities for low-CO_2 technology in the petroleum sector, and assess how existing measures can be strengthened to encourage further technology development. The updated report is due in the third quarter of 2016.

Norwegian Oil and Gas launched a joint industry project on energy management in April 2015. This aims to strengthen the attention paid to energy surveys and efficiency enhancement as well as knowledge-sharing between companies, and develop calculation methods for measures to reduce GHG emissions per unit produced. The industry is also working to strengthen and further develop its collaboration with Enova, both on energy management and on developing technology which cuts energy requirements and GHG emissions. The main project is due to be completed by the end of 2016.

Norwegian Oil and Gas has collaborated closely with the NEA on establishing a better database for emissions of short-lived climate forcers, such as CH_4 and nmVOC. See section 6.5 for more details.

Figure 21 shows that GHG emissions from the NCS totalled 14.2 million tonnes of CO_2 equivalent in 2015, compared with 13.9 million the year before. The main reasons for the rise were higher output than in 2013 from older fields which require more energy to produce, and a greater energy requirement for gas exports. According to Statistics Norway, Norwegian emissions totalled 53.2 million tonnes of CO_2 equivalent in 2015[1] – a slight decline from the year before. The petroleum industry accounted for about a quarter of the 2015 figure.

[1] Preliminary figure.

6.3 GREENHOUSE GAS EMISSIONS

FROM NORWEGIAN AND INTERNATIONAL PETROLEUM OPERATIONS

About a quarter of Norway's total value creation measured by GDP currently derives from the petroleum sector, which accounted for a similar proportion of national CO_2 emissions in 2015. The oil and gas industry's contribution to emission reductions will thereby also represent an important part of the climate solution.

A number of instruments are used by the Norwegian government to regulate emissions from the oil and gas business. The most important of these are the CO_2 tax, Norway's participation in the EU ETS, flaring provisions in the Petroleum Act, the requirement to assess power from shore when planning developments, emission permits, and the BAT requirement. These instruments have unleashed a number of measures by the petroleum sector, and broad studies by both the industry itself and the government have documented in recent years that the Norwegian oil and gas industry has acted to reduce its emissions by the equivalent of more than five million tonnes of CO_2 every year since 1996.

The result is an offshore industry in the international premier division for energy-efficient production and low CO_2 emissions per unit produced. At the same time, certain other oil provinces are increasingly able to point to clear environmental improvements by instituting production patterns similar to those on the NCS, such as reduced flaring. This is very positive. Less flaring both cuts CO_2 emissions and boosts energy supplies for more people, since the gas will be consumed rather than flared.

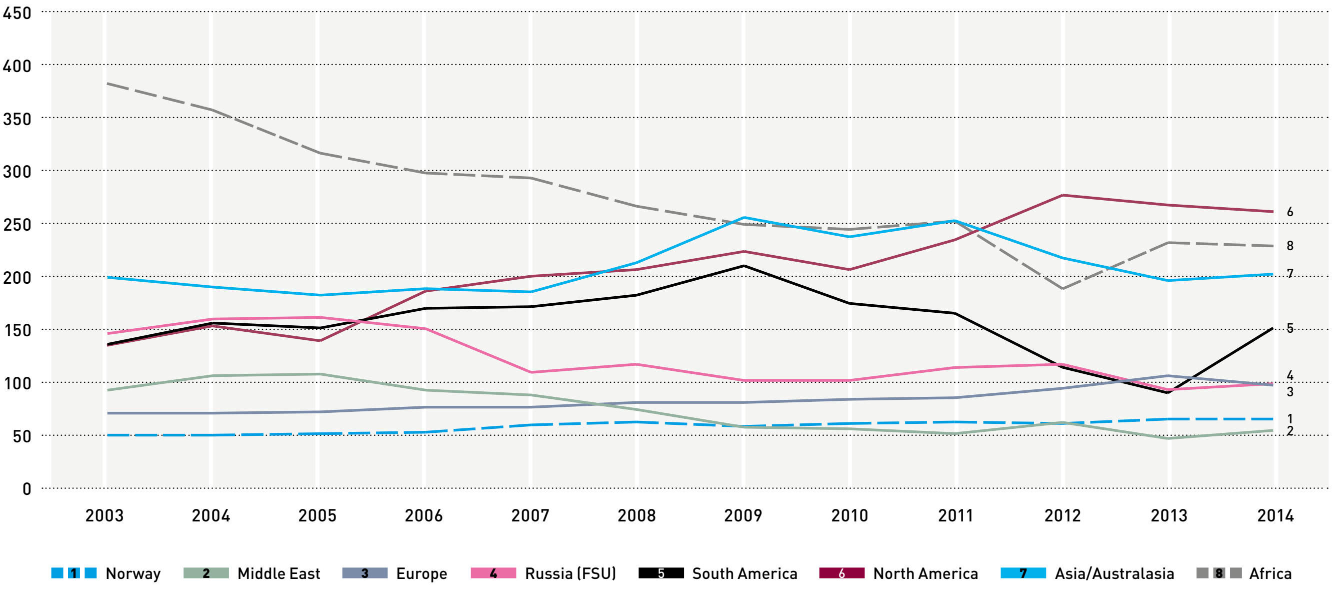
Every company in Norway reports all its emissions pursuant to the applicable regulations. This is not the case in certain other petroleum provinces. In the Middle East, for example, emission figures were reported for only about 20 per cent of production in 2014.

The Norwegian offshore sector is a world leader for recovery factors. That means a number of fields are mature, and recovering their remaining reserves is energy-intensive. Norway's petroleum sector nevertheless also ranks among the best in the world for low CO_2 emissions per unit produced.

The Norwegian petroleum industry pays for its emissions both through the CO_2 tax, which it has been subject to since 1991, and by buying allowances in the EU ETS since 2008. The CO_2 tax rate at 1 January 2016 was NOK 1.02 per scm of gas or litre of oil or condensate, corresponding to about NOK 436 per tonne of CO_2. This tax has prompted, and continues to prompt, measures to cut emissions on the NCS.

FIGURE 22 **GHG EMISSIONS PER UNIT PRODUCED IN VARIOUS PETROLEUM PROVINCES 2003-14 (KG OF CO_2 EQUIVALENT PER TONNE OF OE PRODUCED)**

Sources: IOGP and EEH




25/4 HEIMDAL
STATOIL

6.4 EMISSIONS OF CO_2

CO_2 emissions from operations on the NCS totalled 13.5 million tonnes in 2015, compared with 13.1 million the year before. This increase reflects higher production.

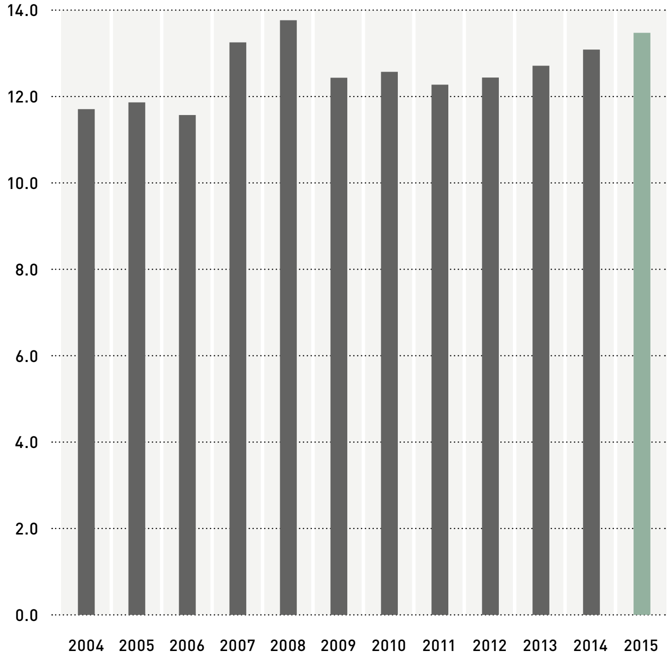
The oil and gas industry released 13.5 million tonnes of CO_2 and accounted for just under a quarter of Norwegian emissions in 2015 – roughly the same proportion as the year before.

The breakdown by source was little changed from 2014.

Figure 25 presents the historical trend for direct and indirect CO_2 emissions per volume of hydrocarbons delivered in the 1990-2015 period. Specific CO_2 emissions in 2015 amounted to 52.5 kilograms per scm oe produced.

CO_2 emissions per unit produced (specific CO_2 emissions) have risen over the past 15 years. This reflects increased energy requirements on aging fields for recovering the remaining oil and, to some extent, the growing share of gas needing energy for compression before export to Europe. However, specific CO_2 emissions have been stable over the past two years. The industry's clear ambition is to continue improving CO_2 emissions per unit produced on the NCS.

FIGURE 23 HISTORICAL DEVELOPMENT OF DIRECT CO_2 EMISSIONS (MILL TONNES) AND BREAKDOWN BY SOURCE IN 2015 (PER CENT)



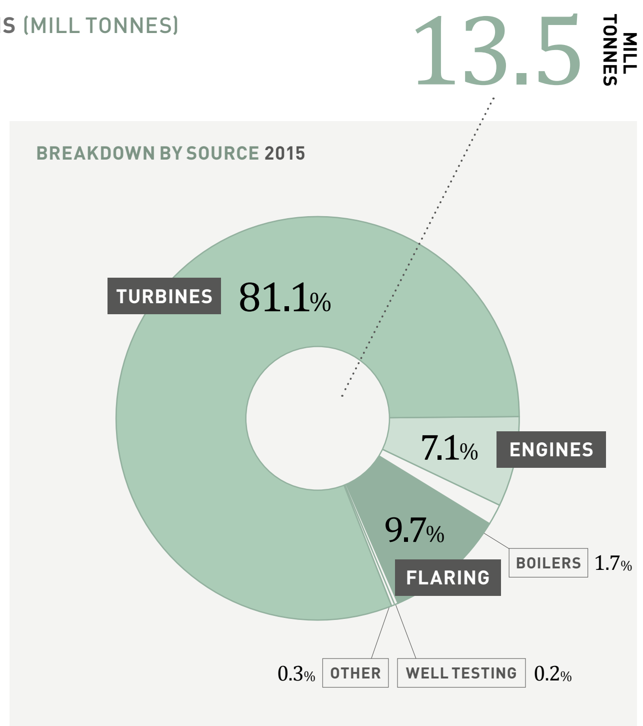


FIGURE 24 HISTORICAL DEVELOPMENT OF FLARE GAS CONSUMPTION (SCM) AND ASSOCIATED CALCULATED CO_2 EMISSIONS (TONNES)

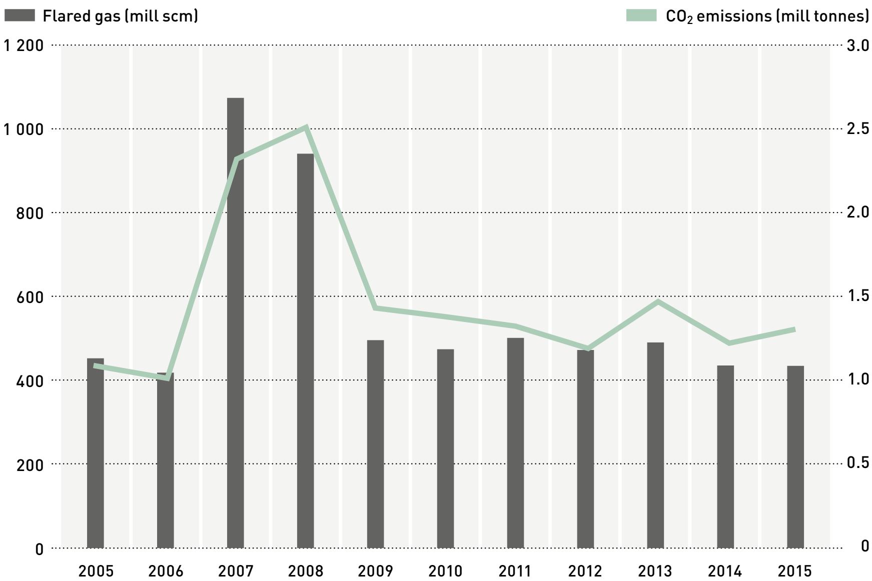
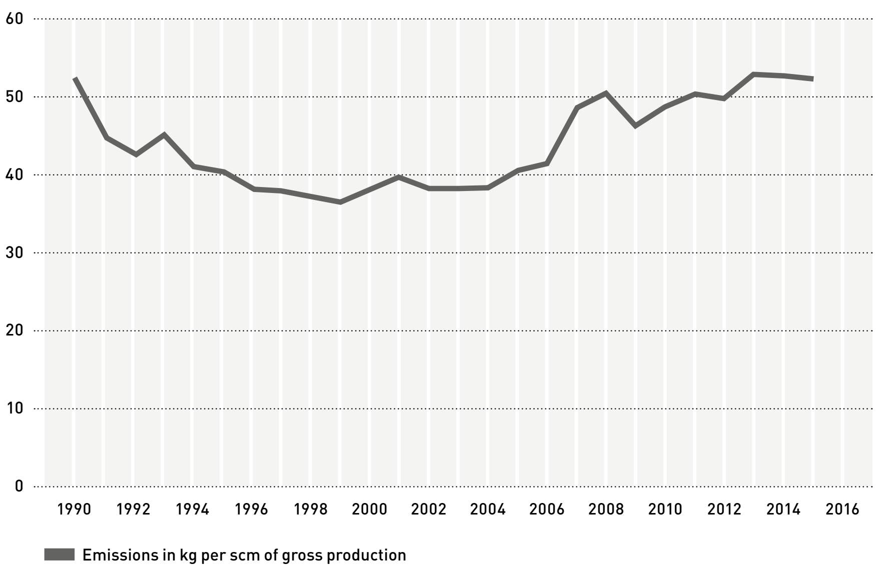


FIGURE 25 SPECIFIC CO_2 EMISSIONS (KG/SCM OE)



The industry's clear ambition is to continue improving CO_2 emissions per unit produced on the NCS.

6.5 SHORT-LIVED CLIMATE FORCERS

Short-lived climate forcers (SLCFs) such as CH_4 and nmVOC are on the political agenda in Norway and internationally. Emissions of these substances from production on the NCS are already small in a global context. Preliminary results from a collaboration project with the NEA to improve emission data on the NCS indicate that the amounts released are rather lower than previously estimated.

A number of initiatives are being pursued globally through the Climate and Clean Air Act Coalition (CCAC). Ambitions have also been expressed in the Svalbard Declaration of 2012 for the Nordic countries, the Arctic Council's Tromsø Declaration of 2009 covering eight Arctic nations, and the revised Gothenburg Protocol of 2012.

SLCFs comprise particles and gases characterised by a strong impact on climate and health, but a limited lifespan in the atmosphere. Reducing their emission could therefore have a rapid effect on both climate and health. Where they are emitted also has great significance. Growing attention is accordingly being paid to flaring and the consequences of this type of emission. CH_4 and nmVOC are SLCFs. For safety reasons, great attention is already being paid to emissions of these components on the NCS.

The CCAC has established a voluntary initiative known as the CCAC Oil and Gas Methane Partnership (OGMP) to reduce CH_4 emissions from the petroleum sector. This was officially launched by the UN secretary-general in September 2014. Statoil, BG Group, Total and Eni were among the companies behind the initiative.

A need has existed to update and further enhance knowledge about the various sources of direct CH_4 and nmVOC emissions. The industry has therefore collaborated closely with the NEA to improve the quality of emission data and to identify possible measures which could reduce the quantities released. A number of reports from this study posted to the NEA's website indicate that the emission factors utilised on the NCS have been on the high side. New factors will be incorporated in the requirements for company reporting during 2016 and applied with effect from the 2017 production year.

GAS-FIRED POWER STATIONS AS A CLIMATE MEASURE

The natural gas used in households, industry and gas-fired power stations consists primarily of CH_4. Burning gas to generate electricity emits only half the amount of CO_2 per unit of power as a coal-fired facility. Converting from coal-based to gas-based generation is therefore widely regarded – not least by the EU – as a possible climate measure. However, CH_4 has 25 times the greenhouse effect of CO_2. Leaks from the gas pipeline system corresponding to only three per cent of the distributed volume could thereby eliminate this climate benefit.

Efforts to avoid leaks have long been given priority on the NCS for both safety and environmental reasons. As a result, emissions related to NCS gas production are only about 0.1 per cent of the volume produced. However, overall leakage from source to consumer must be considered when comparing coal- and gas-fired power generation. An extensive study of leakage from the EU's 2.2 million kilometres of transport and distribution pipelines has now been published. This shows that CH_4 emissions are about 0.1 per cent from the transport system and 0.4 per cent in the distribution network, so that total leakage from the NCS to EU consumers is about 0.6 per cent. The study also shows that these emissions are declining. This supports the view that natural gas is a good climate alternative to coal for electricity generation from power stations. In addition come all the other emissions to the air from using coal in energy production, which have substantial negative effects on local air quality.

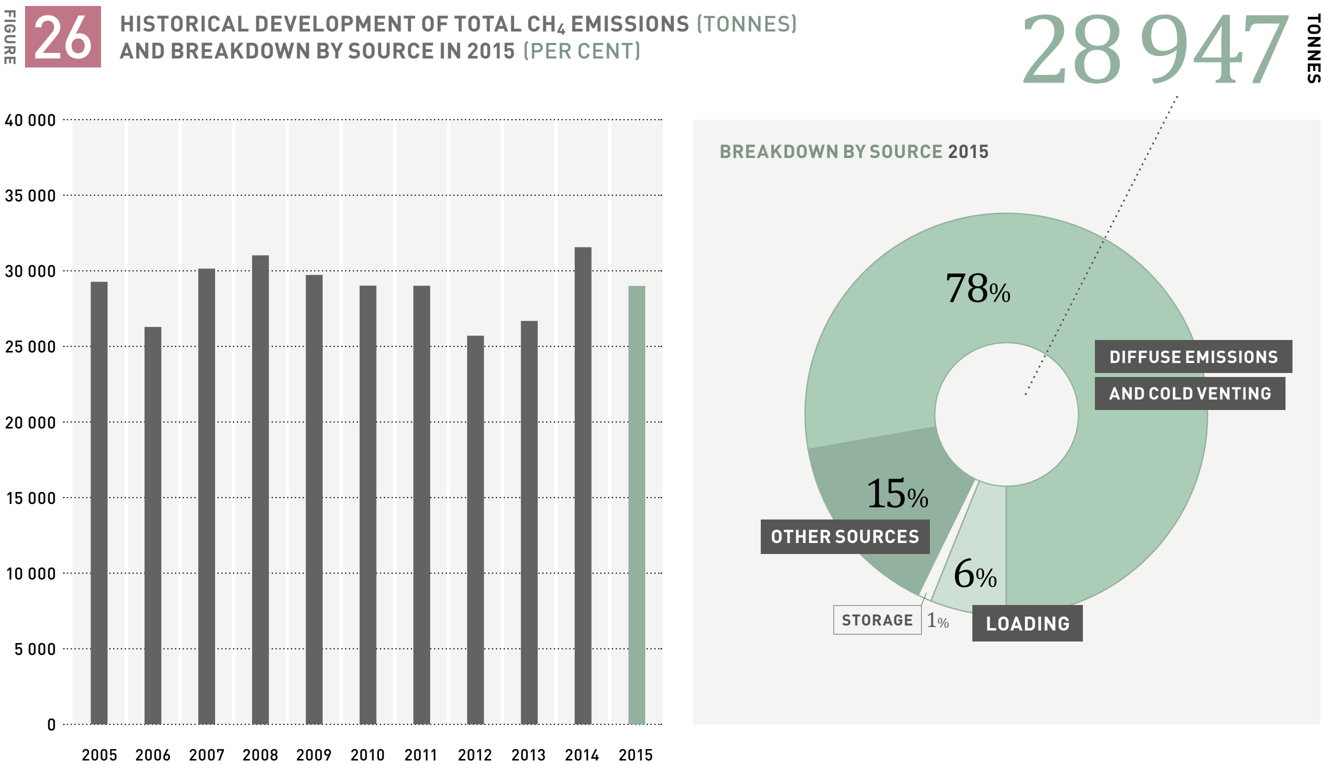
Questions have been raised about CH_4 emissions from Norwegian gas production and the use of this commodity in Europe on the basis of the three per cent issue mentioned above. These doubts have been based on figures for emissions to the air from shale gas output in the USA. According to some earlier theoretical calculations, such production released substantial quantities of GHG. These figures have since been corrected through extensive studies and measures pursued jointly by the Environmental Defence Fund (EDF), the industry and several universities. This work involves both wide-ranging field studies and new modelling based on these measurements. The results show that CH_4 emissions from gas production and consumption in the USA amount to 1.3 per cent of total output and is on the way down.

6.6 EMISSIONS OF CH_4

Figure 26 presents emissions of CH_4 from operations on the NCS and the breakdown of these by source in 2015, when a total of 28 947 tonnes was released. The share of CH_4 emissions from offshore loading of oil to shuttle tankers has declined drastically and now accounts for less than six per cent of the total. Cold venting and diffuse emissions from flanges, valves and various types of process equipment represent the biggest sources of CH_4 from the oil and gas industry. The rise in emissions primarily reflects new fields coming on stream, increased production and higher volumes released from valves and cold venting.

According to Statistics Norway, Norwegian CH_4 emissions totalled 219 513 tonnes in 2015. The petroleum sector accounted for 13.7 per cent of this figure, more or less unchanged from recent years.

FIGURE 26 HISTORICAL DEVELOPMENT OF TOTAL CH_4 EMISSIONS (TONNES) AND BREAKDOWN BY SOURCE IN 2015 (PER CENT)



6.7 EMISSIONS OF nmVOC

Overall nmVOC emissions have been cut significantly since 2001. These substantial reductions reflect investment in new facilities for removing and recovering oil vapour on storage ships and shuttle tankers.

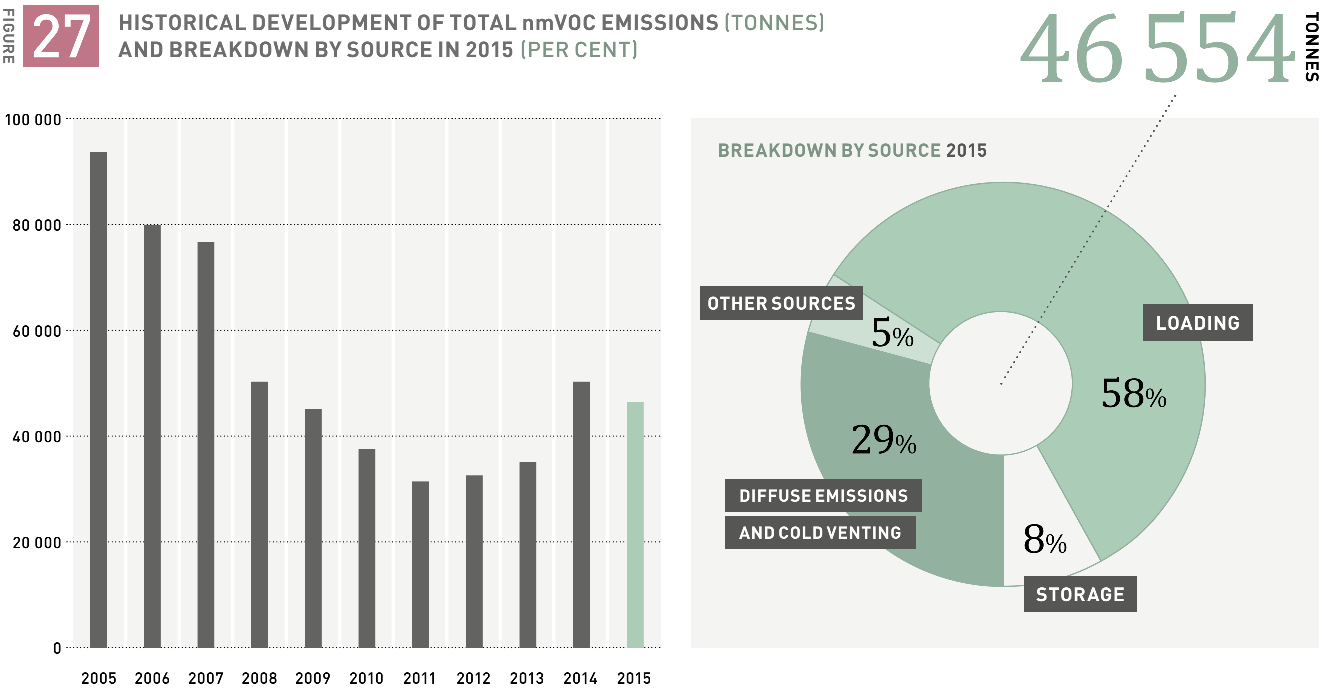
Uncertainty has arisen over the actual size of the reduction effect achieved by one of the technological solutions. The NEA and the VOC Industry Collaboration[1] have accordingly cooperated on finding improved ways of documenting these emissions.

Equipment for metering nmVOC was installed on selected vessels in 2014, and verification measurements have been conducted at all major loading points. These show that the technology used on a number of the ships during loading has limited or no effect on reducing the release of nmVOC to the air. Emission figures for nmVOC during loading in 2014 accordingly showed a rise from the year before. See figure 27. NmVOC emissions from loading on the NCS in 2015 were 26 960 tonnes, a slight reduction from 28 205 tonnes in 2014.

Total nmVOC emissions for 2015 came to 46 554 tonnes, down from 49 755 tonnes the year before. Statistics Norway estimates total Norwegian nmVOC emissions in 2015 at 139 736 tonnes, with the oil and gas industry accounting for 35 per cent of this figure.

[1] The VOC Industry Collaboration (VOCIC) was established in 2002 to reduce emissions of nmVOC from offshore loading, and is led by a board comprising representatives from Statoil (chair), Det Norske Oljeselskap, ExxonMobil and Norske Shell. All the companies using shuttle tankers on the NCS are members of the VOCIC. This collaboration has made it possible to fulfil government requirements for cutting nmVOC emissions in a cost-effective manner.

FIGURE 27 HISTORICAL DEVELOPMENT OF TOTAL nmVOC EMISSIONS (TONNES) AND BREAKDOWN BY SOURCE IN 2015 (PER CENT)



6.8 THE NO_X AGREEMENT AND INTERNATIONAL OBLIGATIONS

The environmental agreement on NO_x regulates the commitments made to the government by Norway's industry associations on reducing their overall NO_x emissions. Norway has already met its NO_x commitments for 2020 under the Gothenburg Protocol. Efforts to reduce emissions through the NO_x fund have been crucial for this result.

All the companies signed up to the agreement report their emissions to the business fund for NO_x as the basis for their obligation to pay into the fund. At 31 March 2016, 897 enterprises were signed up to the agreement, including all the operator companies on the NCS. Since its launch in 2008, the fund has resulted in 783 verified measures which have received investment grants. These yielded an overall reduction of 32 183 tonnes of NO_x between 1 January 2008 and 31 March 2016. The commitment for 31 December 2016 under the environmental agreement is 31 000 tonnes of NO_x.

Although it is a substantial contributor to the fund, the oil industry has few implemented projects in receipt of grants because the cost of measures on the NCS is generally high. The fund model used for this agreement ensures that emission reductions are implemented where they yield the biggest environmental return per krone spent.

The fund has also made an important contribution to the development of new environmentally efficient solutions, and of new markets and market players. Examples include the further development of solutions for gas-fuelled ships, environment-friendly conversion of marine engines, use of catalytic converters to treat emissions with urea, and the installation of fuel-efficient solutions. Viewed overall, the market has both secured new developments and expanded the use of established NO_x-reducing solutions. New suppliers have also secured help in a vulnerable phase in order to establish themselves in the market with support from the fund.

A positive additional effect is that measures which reduce NO_x emissions by cutting fuel consumption also reduce the amount of CO_2 released. The overall impact of measure in the NO_x fund's portfolio is a decline of about 560 000 tonnes per annum in CO_2 emissions for measures implemented.

Experience indicates that the emission reductions achieved are significantly higher with an environmental agreement than they were with the fiscal NO_x tax in 2007. Financing measures from the fund means increased cuts at a significantly lower financial burden for the companies, while the reductions in the agreement are achieved with a greater degree of certainty.

Since 2015, the NO_x fund has worked to have the environmental agreement extended beyond 2017. This is important in order to continue work on reducing these emissions and thereby fulfil both national and international commitments. Measures and industrial projects of some size, such as newbuilding of ships, have long planning time frames. That makes it important to clarify the continuation of the agreement as quickly as possible, so that action can also be planned and implemented beyond its present duration.

The overall impact of measure in the NO_x fund's portfolio is a decline of about 560 000 tonnes per annum in CO_2 emissions for measures implemented.

6.9 EMISSIONS OF NO_X

Petroleum operations emitted a total of 46 757 tonnes of NO_x in 2015, a marked decline from 52 375 tonnes the year before. This reduction reflected lower emissions from engines because the use of mobile units fell.

Figure 28 presents NO_x emissions from operations on the NCS and how these broke down by source in 2015. According to Statistics Norway, Norwegian NO_x emissions for the year totalled 147 811 tonnes, a decline of just over five per cent from 2014. The oil and gas industry accounted for roughly 36 per cent of this figure. The biggest source of NO_x emissions from petroleum activities is combusted gas in turbines on offshore installations.

Specific NO_x emissions in 2015 totalled 0.18 kg/ scm oe delivered, a marked decline from the year before. The reason for this was reduced consumption of diesel oil as fuel because of a lower level of activity.

FIGURE 29 SPECIFIC NO_X EMISSIONS (KG/SCM OE)

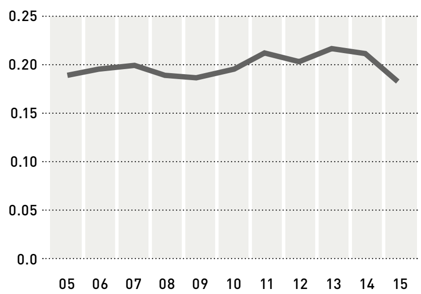
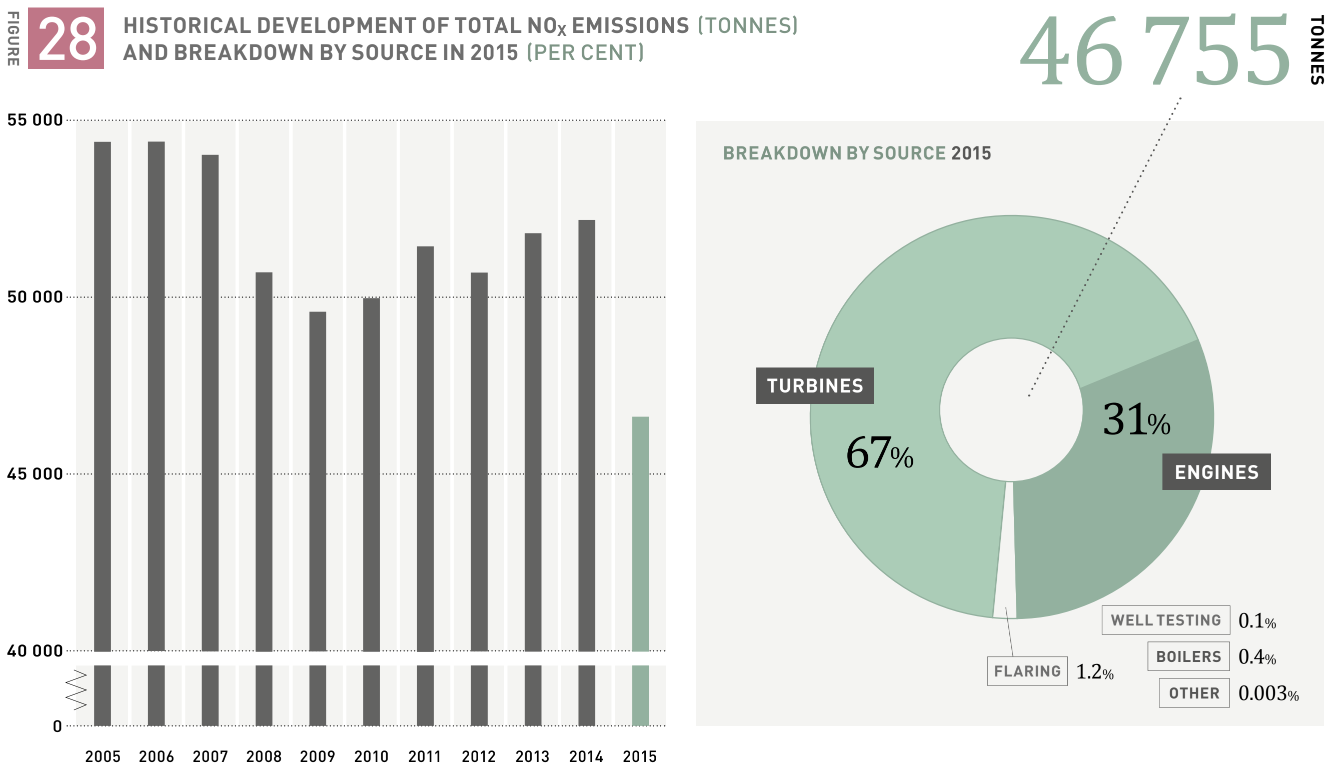


FIGURE 28 HISTORICAL DEVELOPMENT OF TOTAL NO_X EMISSIONS (TONNES) AND BREAKDOWN BY SOURCE IN 2015 (PER CENT)



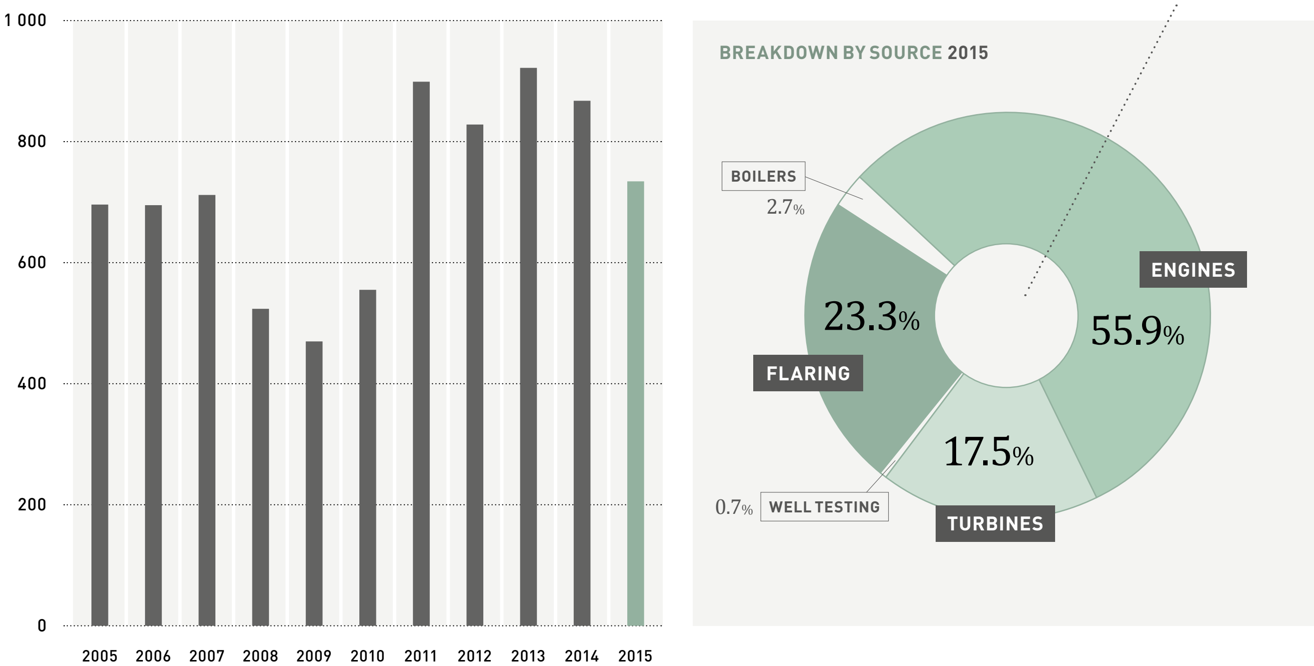
6.10 EMISSIONS OF SO_X

Figure 30 shows SO_x emissions from operations on the NCS and their breakdown by source in 2015. Total emissions in 2015 came to 736 tonnes, down from 868 tonnes the year before.

According to Statistics Norway, Norwegian SO_x emissions totalled 16 666 tonnes in 2015. The petroleum sector accounted for 9.6 per cent of this figure.

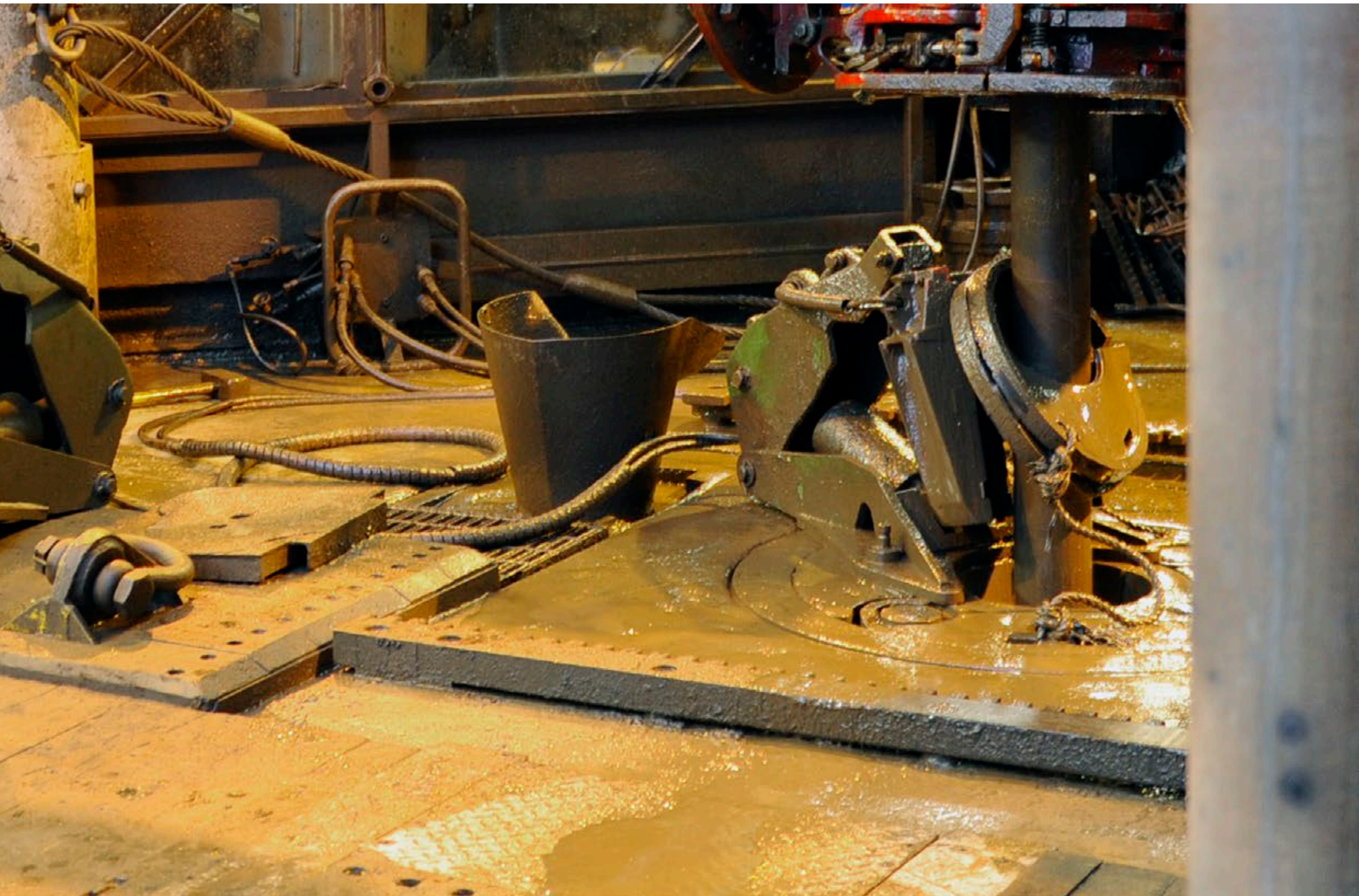
FIGURE 30 HISTORICAL EMISSIONS OF SO_X FROM THE NCS (TONNES) AND BREAKDOWN BY SOURCE IN 2015 (PER CENT)

736 TONNES



7 WASTE

THE PETROLEUM SECTOR IS THE LARGEST GENERATOR OF WASTE IN NORWAY. TO ENSURE APPROPRIATE TREATMENT AND DISPOSAL OF THESE VOLUMES, THE INDUSTRY CONTRIBUTES TO IMPROVING THEIR CLASSIFICATION AND DECLARATION.



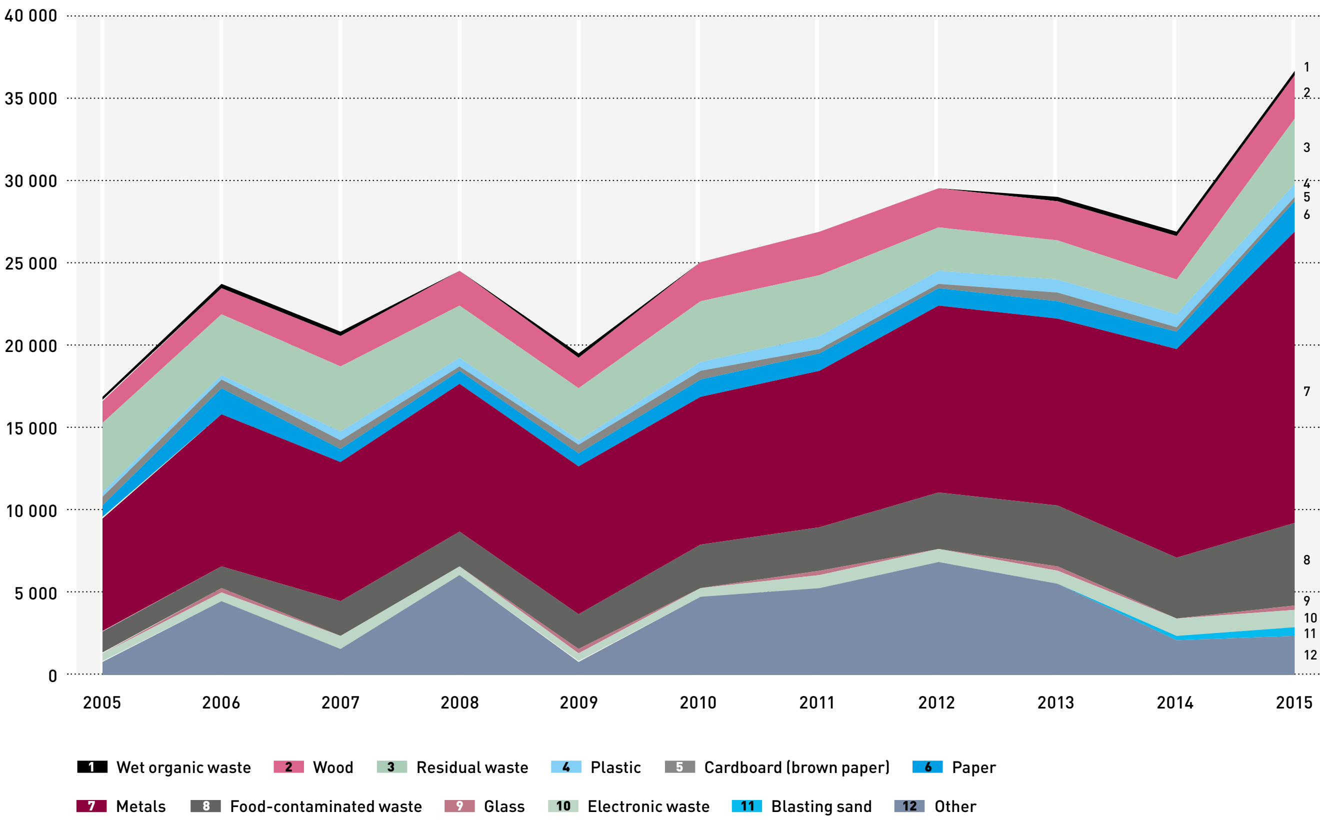
The industry places great emphasis on prudent waste management. Generally speaking, waste is divided into hazardous and non-hazardous categories, and must be declared pursuant to national regulations and international guidelines. The principal goals of the operators are to generate a minimum of waste and to establish systems for recycling as much of it as possible. Norwegian Oil and Gas has developed its own guidelines for waste management in the offshore sector. These are used in declaring and further treatment of the waste. All waste is sent ashore in accordance with the industry's guidelines.

NON-HAZARDOUS WASTE
Non-hazardous waste totalled just under 37 000 tonnes in 2015, up by almost 10 000 tonnes from the year before. This primarily reflected increased quantities of metal sent ashore.

HAZARDOUS WASTE
Some 464 000 tonnes of hazardous waste were delivered for treatment on land in 2015, a small increase from 424 000 tonnes the year before. The largest proportion, as much as 259 000 tonnes, comprised drilling waste – primarily cuttings contaminated with oil-based fluid. However, this volume included substantial quantities of water added as part of the slurrification process to make the cuttings easier to handle. In addition came 120 000 tonnes of oily process water.

A substantial growth in oily waste has occurred in recent years. To a great extent, this reflects problems with leaks from injection wells on several fields in 2009-10 and a subsequent halt to further injection. Oily waste which was previously injected had to be sent ashore for treatment. Methods for handling cuttings

FIGURE 31 **BREAKDOWN OF NON-HAZARDOUS WASTE FROM THE OFFSHORE INDUSTRY** (2015)



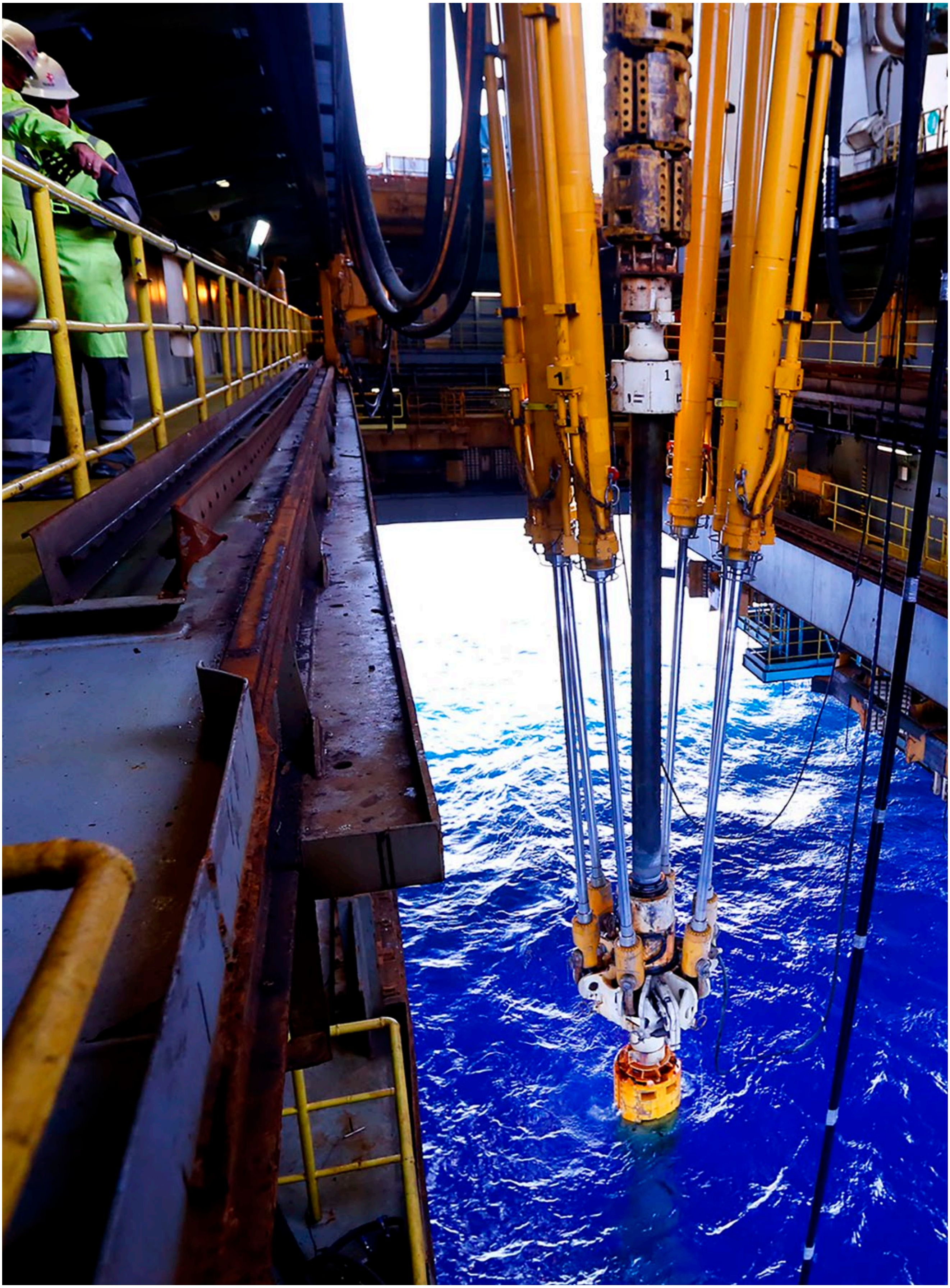
on these installations are based on slurrification with a view to injection. This process involves crushing the cuttings and adding water, and it is not unusual for the volume of cuttings to expand between four- and 10-fold as a result. That practice continued, with cuttings sent ashore as slurry. The result was a marked increase in the quantity of drilling waste from certain fields. Injection provides substantial environmental benefits and can be cost-efficient compared with final treatment on land. Drilling new injection wells on certain fields means that the quantity of injected liquids is again rising a little. See section 4.1. Work to reduce slurrification and thereby cut the quantity of waste is under way on those installations and fields where injection will not be resumed.

In cooperation with the NEA, Norwegian Oil and Gas introduced new codes in 2014 for hazardous waste from the industry. This change was intended to ensure good handling of waste streams with correct declaration of their content. However, comparing the various waste types with earlier statistics is thereby difficult. A number of the categories have been split into several sub-types, while others have been merged.

LOW-LEVEL RADIOACTIVE WASTE

Rocks beneath the seabed contain varying amounts of radium and other radioactive isotopes. These naturally occurring radioactive substances accompany oil, gas and – primarily – water to the surface during production. On some fields, sludge cleaned from oil-water separators can contain varying levels of measurable radioactivity. The concentration of these substances is measured through analyses of water and sludge by accredited laboratories. Such waste is divided into and declared in three categories – no enhanced concentrations, radioactivity below 10 becquerels per gram and radioactivity above 10 Bq/g. Both of the radioactive categories are treated in accordance with regulations issued by the Norwegian Radiation Protection Authority. Waste with the highest activity is sent to a special landfill site in Gulen.

Just over 243 tonnes of low-level radioactive waste were dealt with in 2015, including 129 tonnes dispatched to landfill and 113 tonnes for other treatment.



8 TABLES

TABLE 01 HISTORICAL PRODUCTION DATA FOR OIL, CONDENSATE AND GAS (MILL SCM, GAS BN SCM)

Reporting year	Net oil	Net condensate	Net NGL	Net gas	Total oe
2002	174 865 486	7 324 031	-	65 820 303 166	259 807 998
2003	166 614 992	10 339 364	-	73 415 816 502	263 301 649
2004	164 182 958	8 675 433	316 084	78 808 171 199	265 268 632
2005	149 370 281	7 951 656	1 942 288	85 842 596 215	258 970 408
2006	137 610 860	7 625 019	2 337 065	88 668 287 376	250 599 794
2007	129 672 214	3 126 045	1 645 674	90 309 728 812	239 746 185
2008	124 374 475	3 923 854	1 643 361	100 110 297 994	245 377 278
2009	116 351 165	4 439 725	2 074 443	104 383 601 103	242 157 496
2010	105 506 898	4 163 009	2 030 520	107 250 265 117	232 440 486
2011	98 521 894	4 583 334	1 873 721	101 266 311 436	220 702 498
2012	89 894 020	4 574 854	2 513 187	115 158 151 014	227 475 826
2013	85 552 176	3 991 160	2 444 641	109 277 586 408	216 597 351
2014	88 138 159	2 912 561	2 404 840	109 026 211 431	219 053 637
2015	91 326 753	2 468 274	2 267 947	117 280 783 132	230 694 640

TABLE 02 INJECTION DATA (SCM)

Reporting year	Water	Gas	Gross fuel gas	Gross flared gas
2002	242 144 448	35 876 253 487	3 699 982 317	434 961 692
2003	253 156 503	38 438 509 496	3 836 746 538	444 399 858
2004	251 875 791	42 134 316 220	3 989 877 258	444 775 806
2005	232 077 005	38 688 500 820	3 961 262 435	460 475 621
2006	222 534 757	36 023 255 940	3 931 891 535	471 665 164
2007	209 974 371	39 803 147 192	3 843 055 567	457 262 849
2008	197 868 634	34 127 615 683	3 838 474 433	588 743 054
2009	166 939 471	33 429 627 740	3 765 463 281	384 917 773
2010	153 851 370	29 408 435 484	3 697 531 369	380 399 245
2011	134 912 328	26 838 327 689	3 567 088 643	371 340 687
2012	130 556 861	26 370 349 599	3 650 843 648	342 420 089
2013	119 829 977	29 346 604 634	3 557 334 571	430 319 857
2014	133 726 405	34 724 594 142	3 827 772 021	345 026 015
2015	143 297 617	35 295 355 706	4 031 096 122	301 767 090

TABLE 03 DRILLING WITH OIL-BASED FLUIDS (TONNES)

Reporting year	Base fluids Consumption	Base fluids Discharged	Base fluids Injected	Base fluids Transported to land	Base fluids Left in hole or lost to formation
2006	183 702	-	58 205	38 989	48 343
2007	182 381	-	53 301	42 877	50 636
2008	185 891	-	51 819	50 888	51 165
2009	219 217	-	45 728	71 157	53 745
2010	147 447	-	27 438	55 220	64 789
2011	118 305	-	14 954	55 895	47 456
2012	117 308	-	18 356	56 238	42 713
2013	147 487	-	38 527	60 690	48 270
2014	128 187	-	26 789	60 019	41 378
2015	171 386	47	29 209	70 217	71 912

TABLE 04 DRILLING WITH SYNTHETIC FLUIDS (TONNES)

Reporting year	Base fluids Consumption	Base fluids Discharged	Base fluids Injected	Base fluids Transported to land	Base fluids Left in hole or lost to formation
2006	0				
2007	-	-	-	-	-
2008	968	-	-	630	338
2009	-	-	-	-	-
2010	0				
2011	2 888	-	-	1 126	1 762
2012	0				
2013	1 444	-	-	601	843
2014	816	-	395	-	421
2015	0	0	0	0	0

TABLE 05 DRILLING WITH WATER-BASED FLUIDS (TONNES)

Reporting year	Base fluids Consumption	Base fluids Discharged	Base fluids Injected	Base fluids Transported to land	Base fluids Left in hole or lost to formation
2006	267 310	196 680	22 139	9 956	23 634
2007	270 999	203 487	27 243	9 938	17 515
2008	274 337	175 292	33 151	20 590	26 471
2009	412 719	280 013	20 320	24 600	31 268
2010	290 684	231 378	12 162	15 341	31 802
2011	316 379	228 222	30 302	21 888	35 967
2012	331 820	238 652	25 371	26 272	41 525
2013	387 426	295 668	18 545	23 277	49 936
2014	388 739	280 276	21 051	31 497	55 915
2015	328 851	219 158	33 209	20 978	55 506

TABLE 06 DISPOSAL OF CUTTINGS FROM DRILLING WITH OIL-BASED FLUIDS (TONNES)

Reporting year	Base cuttings exported to other fields	Base cuttings Discharged to sea	Base cuttings Volume injected	Base cuttings Transported to land	Total amount cuttings/ mud generated
2005	-	-	60 242	20 287	80 189
2006	-	-	54 433	22 679	77 435
2007	467	-	50 321	28 066	78 961
2008	-	-	49 108	24 854	73 562
2009	424	-	47 640	38 316	86 386
2010	-	-	26 938	81 188	108 126
2011	-	-	19 699	68 190	87 810
2012	-	-	23 409	65 689	89 098
2013	-	-	37 896	53 232	91 128
2014	-	-	22 253	55 061	77 314
2015	-	2 460	36 189	71 299	109 949

TABLE 07 DISPOSAL OF CUTTINGS FROM DRILLING WITH WATER-BASED FLUIDS (TONNES)

Reporting year	Base cuttings exported to other fields	Base cuttings Discharged to sea	Base cuttings Volume injected	Base cuttings Transported to land
2006	325	80 757	1 423	2 226
2007	-	91 761	1 191	894
2008	651	73 639	2 717	2 501
2009	-	129 674	1 624	104
2010	-	207 655	664	9 896
2011	-	195 062	5 741	10 885
2012	-	171 842	1 169	3 774
2013	-	123 005	50	2 210
2014	-	113 840	24	525
2015	1 239	99 424	-	2 405

TABLE 08 TOTAL AMOUNT OF CUTTINGS/MUD IMPORTED TO FIELDS (TONNES)

Reporting year	Oil-based
2006	2 383
2007	1 668
2008	3 692
2009	7 579
2010	14 994
2011	91
2012	0
2013	0
2014	0
2015	0

TABLES

TABLE 09 SELECTED GROUPS OF ORGANIC COMPOUNDS DISCHARGED IN PRODUCED WATER (KG)

Substance	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
BTEX	1 644 661	1 826 674	1 803 998	1 902 925	1 818 173	1 675 059	1 855 037	1 922 626	1 909 696	2 268 533
Phenols	531 046	566 762	544 857	508 365	487 429	492 449	523 242	505 708	653 851	633 705
Oil in water	1 057 837	1 178 851	947 549	1 156 501	1 200 078	1 235 608	1 325 326	1 712 316	1 560 328	1 645 533
Organic acids	34 838 267	35 818 064	31 263 700	27 204 909	24 752 275	22 251 835	22 144 558	53 789 394	31 592 634	30 415 062
PAH compounds	156 867	126 343	129 468	153 177	142 408	157 778	168 160	157 896	169 764	131 426
Heavy metals	7 519 086	7 959 150	8 838 787	7 814 585	7 905 978	8 611 126	8 424 293	7 979 933	9 063 413	9 845 943

TABLE 10 BTX COMPOUNDS DISCHARGED IN PRODUCED WATER (KG)

Substance	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Benzene	771 347	871 200	862 411	868 175	832 031	771 333	848 713	867 970	973 116	1 021 530
Ethylbenzene	34 271	34 565	34 675	46 135	41 758	37 913	43 761	45 992	53 131	52 764
Toluene	628 213	674 719	672 398	722 851	700 550	655 169	710 617	736 238	725 968	828 299
Xylene	210 830	246 189	234 513	265 764	243 835	210 644	251 946	272 427	157 481	365 941

TABLE 11 HEAVY METALS DISCHARGED IN PRODUCED WATER (KG)

Substance	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Arsenic	380	660	614	483	895	656	604	622	645	746
Barium	6 137 119	6 939 336	7 762 350	7 008 907	7 071 530	7 639 584	7 554 262	7 321 592	8 219 090	9 061 675
Lead	348	255	386	290	239	428	309	70	191	84
Iron	1 370 415	1 008 440	1 058 121	797 369	825 822	959 698	863 198	653 691	833 664	780 463
Cadmium	30	28	41	28	22	32	18	7	11	5
Copper	730	103	102	102	89	162	143	109	249	128
Chrome	192	175	213	154	225	221	131	107	124	99
Mercury	7	6	11	9	9	15	13	8	8	9
Nickel	735	299	299	142	200	223	198	119	128	1 210
Zinc	9 129	9 847	16 651	7 100	6 948	10 108	5 418	3 608	9 303	1 523

TABLE 12

PHENOLS
DISCHARGED IN PRODUCED WATER (KG)

Substance	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
C1-Alkylphenols	214 511	226 609	207 855	203 376	199 007	186 923	190 276	182 387	266 814	242 415
C2-Alkylphenols	92 631	82 571	87 634	80 707	83 860	82 207	70 392	74 647	89 033	98 818
C3-Alkylphenols	28 794	32 074	29 137	26 108	27 350	29 194	39 995	40 560	43 232	43 471
C4-Alkylphenols	12 524	10 438	10 451	11 624	8 707	11 195	11 315	9 470	9 393	10 482
C5-Alkylphenols	3 047	2 076	2 022	1 325	1 551	3 165	4 577	3 742	3 453	3 455
C6-Alkylphenols	51	86	84	78	125	81	52	40	46	66
C7-Alkylphenols	20	26	61	22	55	61	53	96	120	88
C8-Alkylphenols	37	33	39	20	71	45	11	7	15	16
C9-Alkylphenols	23	28	13	64	44	31	8	4	50	7
Phenol	179 405	212 822	207 560	185 041	166 660	179 546	206 564	194 754	241 695	234 887

TABLE 13

ORGANIC ACIDS
DISCHARGED IN PRODUCED WATER (KG)

Substance	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Butyric acid	671 281	777 200	714 602	627 237	519 296	453 964	456 609	552 567	343 341	506 640
Acetic acid	29 837 132	30 327 152	26 381 307	22 509 255	20 693 558	19 028 018	19 045 328	48 550 063	28 083 291	26 327 349
Formic acid	501 911	449 707	314 221	563 669	493 913	450 016	341 274	1 294 782	517 012	495 495
Naphthenic acid	262 712	283 637	250 405	264 051	179 185	99 691	96 547	126 423	124 885	16 343
Valeric acid	344 439	374 276	341 590	338 214	241 354	159 998	165 674	175 702	167 286	176 567
Propionic acid	3 220 793	3 606 091	3 261 575	2 902 484	2 624 969	2 060 148	2 039 125	3 089 857	2 356 819	2 892 668

TABLE 14

PAH COMPOUNDS
DISCHARGED IN PRODUCED WATER (KG)

Substance	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Acenaphthene*	238	200	164	198	196	225	217	418	350	203
Acenaphthylene*	185	45	174	93	83	94	93	127	158	381
Anthracene*	36	36	60	10	7	9	8	36	49	75
Benzo(a)anthracene*	29	13	18	9	8	8	9	15	23	16
Benzo(a)pyrene*	14	6	5	4	3	3	3	7	13	4
Benzo(b)fluoranthene*	132	13	16	9	9	10	10	8	14	16
Benzo(g,h,i)perylene*	17	5	7	6	6	6	6	6	5	8
Benzo(k)fluoranthene*	13	2	4	2	1	1	1	10	5	11
C1-dibenzothiophene	1 521	690	761	667	601	716	808	1 082	1 097	734
C1-Phenanthrene	1 345	1 886	1 589	2 438	2 222	2 873	2 957	2 860	3 086	2 767
C1-naphthalene	50 250	43 939	44 155	47 410	45 000	49 202	54 446	32 299	41 387	31 553
C2-dibenzothiophene	1 453	663	634	939	878	1 160	1 217	1 470	1 612	1 262
C2-Phenanthrene	1 982	1 823	1 976	2 706	2 598	3 747	3 748	4 040	4 247	3 668
C2-naphthalen	21 143	16 086	19 636	24 669	21 880	26 936	27 707	31 184	27 602	18 388
C3-dibenzothiophene	342	71	92	20	22	27	26	4 845	6 822	825
C3-Phenanthrene	187	375	306	662	694	1 157	1 111	1 604	1 743	1 557
C3-naphthalene	11 226	7 813	11 614	21 719	17 219	22 363	23 230	26 265	22 525	13 253
Dibenz(a,h)anthracene*	12	3	4	3	2	3	2	2	2	3
Dibenzothiophene	449	429	394	435	407	465	518	492	517	465
Phenanthrene*	1 723	1 518	1 565	1 712	1 576	1 775	1 781	1 674	2 008	1 981
Fluoranthene*	53	38	28	25	27	45	37	35	43	52
Fluorene*	1 308	1 132	1 166	1 175	1 126	1 384	1 327	1 473	1 599	1 696
Indeno(1,2,3-c,d)pyrene*	12	2	3	2	1	1	2	2	1	17
Chrysene*	61	40	61	42	30	41	38	77	122	97
Naphthalene*	63 073	49 450	44 963	48 175	47 770	45 492	48 816	47 806	54 669	52 338
Pyrene*	64	64	74	49	43	34	41	60	64	57

* Included in EPA-PAH. Naphthalene and phenanthrene were also part of this group until 2010.

TABLE 15

DISCHARGE AND CONSUMPTION OF CHEMICALS BY NEA COLOUR CATEGORY (TONNES)

NEA colour category	Reporting year	2006	2007	2008	2009	2010*	2011	2012**	2013	2014	2015
Green	Consumption	303 976	338 485	351 815	382 892	374 541	351 387	368 849	451 433	420 988	409 276
	Discharge	93 141	113 159	116 614	158 201	127 249	138 019	147 773	153 671	152 255	142 913
Yellow	Consumption	90 592	94 905	95 348	91 886	103 061	80 141	82 881	100 990	95 101	104 138
	Discharge	11 078	12 005	12 957	14 649	11 727	12 305	13 533	14 019	14 546	14 454
Red	Consumption	5 659	5 376	4 323	3 206	2 894	1 842	2 088	3 004	3 172	3 467
	Discharge	39	23	15	21	16	8	8	8	14	67
Black	Consumption	40	50	60	16	1 259	1 140	746	531	691	401
	Discharge	3	1	2	1	1	1	2	7	13	7

* Use of hydraulic oils was included for all fields from 2010. These substances had not been tested at the time and were therefore registered as black.
** Some fields reported discharges of fire extinguishing foam before this became mandatory from 2012. Reporting of these discharges covers all fields with effect from 2014.

TABLE

16 DISCHARGE OF OIL-CONTAMINATED WATER

Water type	2006	2007	2008	2009	
OTHER					
Discharges of dispersed oil (tonnes)					
Discharges of water (cu.m)					
Total water volume (cu.m)					
Water injected (cu.m)					
DRAINAGE					
Discharges of dispersed oil (tonnes)	9	8	10	6	
Discharges of water (cu.m)	902 487	905 416	953 964	917 986	
Total water volume (cu.m)	979 867	963 971	993 156	1 099 819	
Water injected (cu.m)	77 086	53 474	36 298	184 247	
DISPLACEMENT					
Discharges of dispersed oil (tonnes)	78	94	58	55	
Discharges of water (cu.m)	41 633 651	42 080 398	35 781 227	31 567 044	
Total water volume (cu.m)	41 633 651	42 080 398	35 781 227	31 567 050	
Water injected (cu.m)	0	0	0	0	
PRODUSERT					
Discharges of dispersed oil (tonnes)	1 308	1 532	1 569	1 487	
Discharges of water (cu.m)	144 741 847	161 825 645	149 241 700	134 770 215	
Total water volume (cu.m)	173 349 396	182 807 754	173 375 110	158 559 726	
Water injected (cu.m)	31 693 056	26 665 258	30 379 135	29 547 450	
JETTING					
Discharges of dispersed oil (tonnes)	15	26	13	24	

	2010	2011	2012	2013	2014	2015
			0	0	0	0
			4 414	25 506	49 276	26 249
			4 414	27 101	49 871	40 073
			0	2 267 368	267	12 298
	8	8	8	8	11	8
	727 811	867 531	953 596	954 377	984 216	1 014 435
	763 736	891 951	979 802	991 618	1 065 755	1 124 895
	19 875	16 740	18 831	33 566	86 527	102 389
	47	51	58	56	43	40
	31 953 823	27 025 783	31 491 555	32 227 733	33 230 953	33 830 308
	31 953 823	27 025 783	31 491 555	32 227 733	33 230 953	33 830 308
	0	0	0	0	0	0
	1 443	1 478	1 535	1 541	1 761	1 819
	130 842 793	128 550 571	130 909 973	127 833 805	141 006 271	148 181 942
	157 890 256	160 758 982	162 958 696	161 188 862	176 840 378	186 681 015
	33 217 136	31 095 328	32 756 572	37 292 502	39 360 701	42 479 952
	65	53	43	37	43	59

TABLE

17 TOTAL CONSUMPTION, DISCHARGE AND INJECTION OF CHEMICALS BY APPLICATION (TONNES)

Application		2006	2007	2008	2009
A - DRILLING AND WELL CHEMICALS	Consumed	323 238	358 412	365 902	399 053
	Discharged	72 641	91 239	93 190	135 589
	Injected	79 872	78 130	88 506	65 682
B - PRODUCTION CHEMICALS	Consumed	30 069	29 131	31 278	27 720
	Discharged	14 049	15 317	17 208	17 021
	Injected	5 881	3 323	4 046	4 499
C - INJECTION CHEMICALS	Consumed	14 730	15 361	15 517	12 997
	Discharged	132	332	235	200
	Injected	1 742	1 464	1 486	1 485
D - PIPELINE CHEMICALS	Consumed	4 886	5 189	3 385	2 973
	Discharged	1 049	2 015	516	917
	Injected	0	0	0	146
E - GAS TREATMENT CHEMICALS	Consumed	17 760	18 804	22 257	21 381
	Discharged	13 062	11 619	13 124	11 849
	Injected	1 241	757	1 502	1 634
F - AUXILIARY CHEMICALS	Consumed	3 279	6 300	7 135	7 886
	Discharged	2 223	3 653	4 031	4 795
	Injected	369	250	810	501
G - CHEMICALS ADDED TO THE EXPORT FLOW	Consumed	5 866	5 180	5 443	5 085
	Discharged	188	311	439	1 664
	Injected	0	0	0	0
H - CHEMICALS FROM OTHER PRODUCTION LOCATIONS	Consumed	438	434	614	475
	Discharged	917	697	847	753
	Injected	59	41	210	25
K - RESERVOIR MANAGEMENT	Consumed	1	2	15	12
	Discharged	1	2	0	9
	Injected	0	0	0	0

	2010	2011	2012	2013	2014	2015
	409 337	357 665	373 746	470 793	429 087	425 204
	104 966	111 839	113 521	119 005	117 402	107 939
	44 204	37 685	36 627	59 664	54 161	61 878
	26 816	28 564	29 018	31 815	31 802	32 953
	16 001	17 272	19 577	21 968	21 852	20 365
	4 403	4 598	4 082	4 867	4 020	4 973
	11 487	9 830	9 155	9 340	10 011	10 451
	188	212	176	1 173	1 356	1 040
	1 367	1 492	2 945	1 115	1 334	8 076
	2 477	4 609	7 138	3 490	7 161	6 610
	1 308	3 245	4 153	2 361	3 217	4 015
	599	936	494	917	1 282	1 558
	17 905	21 061	22 563	25 535	26 342	25 123
	9 698	11 097	16 079	16 133	16 697	17 302
	1 406	1 628	4 133	668	5 390	5 330
	8 091	8 073	7 671	9 095	9 407	9 645
	4 244	4 489	4 903	5 451	5 236	4 223
	420	377	190	394	334	589
	5 094	4 665	5 269	5 875	6 121	7 281
	1 847	1 483	1 951	615	383	1 781
	0	0	0	0	0	0
	536	0	0	0	0	0
	753	692	952	986	677	773
	117	114	150	100	895	2 690
	14	6	4	16	25	14
	5	2	3	12	9	4
	0	0	0	0	2	5

TABLE 18 CONSUMPTION AND DISCHARGE OF CHEMICALS BY ENVIRONMENTAL PROPERTIES (KG)

NEA category description	NEA colour category	Category		2006	2007	2008
Substances on the Plonor list	Green	201	Consumption	227 536	251 003	259 361
			Discharge	63 424	72 585	76 539
Water	Green	200	Consumption	76 440	87 482	92 454
			Discharge	29 717	40 575	40 075
Other chemicals	Yellow	100	Consumption	90 592	94 905	95 348
			Discharge	11 078	12 005	12 957
Biodegradability < 20%	Red	8	Consumption	2 928	3 017	3 141
			Discharge	18	13	11
Two out of three categories: biodegradability < 60%, log Pow ≥ 3, EC_{50} or LC_{50} ≤ 10 mg/l	Red	6	Consumption	2 730	2 359	1 182
			Discharge	21	10	5
Inorganic and EC_{50} or LC_{50} ≤ 1 mg/l	Red	7	Consumption		0	
			Discharge		0	
Biodegradability < 20% and toxicity EC_{50} or LC_{50} ≤ 10 mg/l	Black	4	Consumption	32	4	1
			Discharge	2	0	0
Biodegradability < 20% and log Pow ≥ 5	Black	3	Consumption	7	1	1
			Discharge	1	1	1
Hormone-disrupting substances	Black	1	Consumption	0	-	20
			Discharge	0	0	1
List of priority chemicals included in result target 1 (priority list), White Paper no 25 (2002-2003)	Black	2	Consumption	1	0	0
			Discharge	0	0	0
Substances thought to be, or which are, hazardous to genes or reproduction	Black	1.1	Consumption		44	38
			Discharge		-	-

	2009	2010	2011	2012	2013	2014	2015
	287 182	286 277	273 274	282 848	347 659	322 308	311 326
	109 905	90 612	99 503	104 496	114 955	107 671	93 953
	95 710	88 264	78 114	86 001	103 774	98 679	97 414
	48 296	36 638	38 515	43 277	38 716	44 584	48 816
	91 886	103 061	80 141	68 454	83 779	77 067	85 617
	14 649	11 727	12 305	7 575	8 088	8 803	8 908
	2 145	2 387	1 493	1 287	1 664	1 821	2 004
	16	14	6	4	4	5	8
	1 061	507	349	801	1 340	1 351	1 414
	5	2	2	4	3	9	16
	0	0	0	0	0	0	50
	0	0	0	0	0	0	44
	1	21	12	11	5	14	4
	0	0	0	1	0	4	3
	1	1 238	1 128	694	476	631	322
	1	1	0	0	3	4	4
	14	-	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	-

TABLES

TABLE 18 CONSUMPTION AND DISCHARGE OF CHEMICALS BY ENVIRONMENTAL PROPERTIES (KG)

NEA category description	NEA colour category	Category		2012	2013	2014	2015
Reach annex IV	Green	204	Consumption				261
			Discharge				137
Reach annex V	Green	205	Consumption				275
			Discharge				6
Yellow in sub-category 1. Expected to biodegrade fully	Yellow	101	Consumption	7 336	8 124	7 755	6 902
			Discharge	3 709	3 843	3 673	3 257
Yellow in sub-category 2. Expected to biodegrade to environmentally non-hazardous substances	Yellow	102	Consumption	4 989	7 472	5 403	5 346
			Discharge	1 768	1 714	1 702	1 508
Yellow in sub-category 3. Expected to biodegrade to substances which could be environmentally hazardous	Yellow	103	Consumption	1	6	1	1
			Discharge	0	1	0	1
Chemicals exempted from ecotoxicological testing. Include Reach annexes IV and V	Yellow	99	Consumption	2 100	1 609	4 876	6 272
			Discharge	482	373	368	779
Substances which lack test data	Black	0	Consumption	40	50	46	74
			Discharge	1	4	5	0

TABLE 19 DISCHARGE OF CONTAMINANTS IN CHEMICALS (TONNES)

Substance	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Arsenic	0.07	0.07	0.19	0.20	0.15	0.18	0.51	0.48	0.23	0.21
Lead	2.29	2.35	1.51	2.52	1.47	1.48	3.51	3.86	2.80	2.44
Cadmium	0.01	0.01	0.01	0.02	0.01	0.01	0.06	0.03	0.06	0.02
Copper	1.78	2.02	2.22	3.88	3.13	1.67				
Chrome	0.48	0.57	0.55	0.81	0.73	0.77	0.88	1.01	0.85	0.61
Mercury	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.02
Organohalogens		0.000			0.000	0.000	0.000	0.008	0.013	0.000

TABLE 20 DISCHARGE OF ADDITIVES IN CHEMICALS TOTAL VOLUME (TONNES)

Substance	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Lead	0.003	0.001	0.000	0.000	0.000	0.003	0.001	0.000	0.000	0.000
Copper	0.004	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Organohalogens	0.005	1.578	1.887	1.528	0.062	0.066	1.026	0.271	3.537	2.358

TABLES

TABLE 21 ACUTE DISCHARGES TO THE SEA

Discharge type	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CHEMICALS										
Number < 0.05 cu.m	35	23	37	59	64	58	60	65	134	81
Number 0.05 – 1 cu.m	40	52	69	61	62	65	57	62	68	49
Number > 1 cu.m	27	44	30	42	32	28	39	31	36	43
Volume < 0.05 cu.m	0.4	0.3	0.4	0.6	0.6	0.6	0.7	0.6	1.1	0.6
Volume 0.05 – 1 cu.m	13	13	20	23	20	25	17	18	21	16
Volume > 1 cu.m	429	5 436	347	13 029	6 245	176	388	1 267	737	1 563
Total number	102	119	136	162	158	151	156	158	238	173
Total volume (cu.m)	443	5 449	367	13 052	6 265	201	406	1 286	759	1 580
OIL										
Number < 0.05 cu.m	78	113	130	106	109	102	103	94	36	24
Number 0.05 – 1 cu.m	37	42	34	37	24	29	24	19	15	17
Number > 1 cu.m	7	12	9	4	7	2	4	6	8	6
Volume < 0.05 cu.m	0.9	1.1	1.0	0.6	0.6	0.6	0.7	0.6	0.3	0.2
Volume 0.05 – 1 cu.m	8	11	8	9	5	9	7	6	4	6
Volume > 1 cu.m	113	4 476	186	104	105	15	9	41	158	34
Total number	122	167	173	147	140	133	131	119	59	47
Total volume (cu.m)	122	4 488	195	114	111	24	17	47	162	40

TABLE 22 EMISSIONS TO THE AIR (TONNES)

Reporting year	Emissions CO_2 (tonnes) direct	Emissions NOx (tonnes)	Emissions SOx (tonnes)	Emissions PAH (g)	Emissions PCB (g)	Emissions dioxins (mg)	Volume fuel gas (scm)	Volume diesel oil (tonnes)	Volume oil (tonnes)	Discharges to the sea from well tests (tonnes)
2006	11 580 054	54 429	695	173 527	4 870	222	4 463 875 458	258 750	8 558	3
2007	13 263 691	53 997	713	28 997	816	38	5 328 169 872	272 199	3 951	1
2008	13 776 426	50 870	526	46 757	1 319	61	5 361 668 937	279 529	7 517	1
2009	12 444 220	49 804	473	62 365	1 757	80	4 824 405 725	312 627	6 920	1
2010	12 581 242	50 048	557	93 851	1 721	78	4 800 873 166	316 645	25 039	3
2011	12 283 631	51 475	899	1 593 389	1 740	79	4 725 836 624	377 017	10 105	3
2012	12 448 717	50 648	825	168 099	2 331	84	4 797 865 506	394 669	10 891	3
2013	12 722 253	52 057	921	47 472	870	40	4 702 505 527	436 831	4 827	1
2014	13 096 390	52 375	868	132 093	2 422	110	5 031 178 493	424 027	11 313	6
2015	13 485 131	46 755	736	58 407	1 071	49	5 291 070 354	356 711	4 854	2

TABLE 23 **EMISSIONS TO THE AIR BY SOURCE** (TONNES)

Source	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
OTHER SOURCES										
Emissions nmVOC	0	211	809	685	1 363	1 137	49	24	32	36
Emissions CH_4	0	92	581	537	1 635	2 559	185	90	122	134
Emissions SO_x	0	0	0	0	0	0	0	0	0	0
Emissions NO_x	0	0	0	151	63	15	0	2	2	1
Emissions CO_2	2 471	76 603	106 978	91 028	113 691	100 019	62 058	35 031	44 910	42 228
WELL TESTING										
Emissions nmVOC	30	9	13	20	85	30	25	18	38	17
Emissions CH_4	4	2	1	3	8	3	9	0	5	0
Emissions SO_x	14	1	4	12	47	60	13	21	19	5
Emissions NO_x	256	117	69	160	470	168	146	32	98	44
Emissions CO_2	68 001	30 990	23 197	46 011	152 940	55 619	59 745	18 481	52 586	20 231
FLARING										
Emissions nmVOC	25	2 074	236	92	73	76	75	126	75	23
Emissions CH_4	99	3 879	827	321	263	278	267	264	238	90
Emissions SO_x	3	11	3	3	3	224	215	200	201	172
Emissions NO_x	4 867	3 472	979	607	606	589	556	650	553	574
Emissions CO_2	1 011 192	2 317 829	2 514 504	1 438 349	1 379 989	1 319 289	1 199 815	1 471 010	1 217 906	1 307 397
BOILERS										
Emissions nmVOC	29	194	11	17	21	37	33	21	26	38
Emissions CH_4	102	68	79	22	37	32	31	30	19	59
Emissions SO_x	9	4	10	26	12	23	27	16	26	20
Emissions NO_x	246	85	250	78	85	185	155	170	176	205
Emissions CO_2	177 279	122 527	196 580	152 171	115 056	113 354	242 413	235 646	235 658	230 151
ENGINES										
Emissions nmVOC	1 024	1 089	1 072	1 217	1 283	1 554	1 502	1 713	1 721	1 415
Emissions CH_4	29	29	30	19	16	14	15	16	15	18
Emissions SO_x	498	523	402	320	387	488	415	494	486	411
Emissions NO_x	14 503	15 227	14 982	16 302	16 822	19 980	19 703	21 546	21 065	14 413
Emissions CO_2	734 423	779 922	778 988	823 882	856 490	1 025 526	998 860	1 132 633	1 138 908	955 419
TURBINES										
Emissions nmVOC	888	905	898	883	890	867	883	864	933	990
Emissions CH_4	3 377	3 450	3 418	3 354	3 692	3 563	3 653	3 538	3 874	4 118
Emissions SO_x	171	173	106	112	108	105	156	190	136	129
Emissions NO_x	34 557	35 096	34 590	32 506	31 993	30 528	30 088	29 658	30 480	31 517
Emissions CO_2	9 586 688	9 935 821	10 156 180	9 892 780	9 922 026	9 630 473	9 885 826	9 829 452	10 406 423	10 929 706

TABLE 24 EMISSIONS OF CH_4 AND nmVOC FROM DIFFUSE SOURCES AND COLD VENTING (TONNES)

Reporting year	nmVOC emissions	CH_4 emissions
2006	6 617	14 057
2007	7 712	14 984
2008	9 114	19 023
2009	9 161	18 483
2010	7 186	18 068
2011	8 254	19 181
2012	10 083	18 267
2013	9 184	19 854
2014	13 553	24 922
2015	13 351	22 474

TABLE 25 EMISSIONS FROM WELL TESTING

Reporting year	Combusted diesel (tonnes)	Combusted gas (cu.m)	Combusted oil (tonnes)
2006	43	18 662 837	8 558
2007	0	8 502 039	3 951
2008	0	4 609 552	3 864
2009	14	11 509 318	6 302
2010	48	31 426 218	24 989
2011	88	11 266 462	8 555
2012	0	8 560 987	10 891
2013	27	1 173 525	4 827
2014	21	4 804 194	11 007
2015	93	1 796 427	4 854

TABLE 26 EMISSIONS OF CH_4 AND nmVOC FROM STORAGE AND LOADING (TONNES)

Type	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
STORAGE										
Emissions nmVOC	4 251	2 099	3 578	6 397	4 655	4 041	2 978	7 160	5 171	3 724
Emissions CH_4	580	119	332	998	1 107	596	337	1 114	703	355
LOADING										
Emissions nmVOC	66 677	61 954	34 714	27 032	22 646	15 072	17 409	16 144	28 347	26 960
Emissions CH_4	7 940	7 521	6 631	5 890	4 141	2 711	2 894	1 783	1 701	1 699

TABLE 27 SEPARATED WASTE BY SOURCE (TONNES)

Type	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Other	4 669	1 763	6 094	951	4 747	5 425	7 043	5 700	2 279	2 581
Blasting sand	14	0	3	-	1	3	-		161	482
EE waste	461	647	631	530	590	773	692	775	986	990
Glass	105	104	86	98	94	115	115	104	114	316
Food-contaminated waste	1 464	1 969	2 042	2 198	2 622	2 781	3 390	3 694	3 667	5 067
Metals	9 305	8 653	8 856	8 945	9 059	9 432	11 180	11 538	12 637	17 531
Paper	1 497	711	810	828	926	980	1 100	1 005	1 119	1 841
Cardboard (brown paper)	443	537	442	414	440	483	457	465	326	420
Plastic	337	465	427	490	597	635	676	736	748	670
Residual waste	3 707	4 028	3 211	3 079	3 718	3 750	2 586	2 503	2 183	3 873
Wood	1 620	1 939	1 916	1 855	2 385	2 604	2 338	2 441	2 461	2 630
Wet organic waste	161	207	143	120	107	89	115	270	361	418

TABLE 28 HAZARDOUS WASTE (TONNES)

Type	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Other waste	1	5	2	0	5	7	12	28	90	95
Batteries		1	99	79	73	143	111	140	200	127
Blasting sand		8	148	238	146	454	479	465	684	11 486
Drilling-related waste	115 821	134 220	143 326	148 719	257 968	303 500	137 312	259 904	325 885	396 148
Well-related waste								14 626	7 781	6 747
Spent catalysts						2				10
Chemicals		1	73	101	89	162	152	1 003	3 086	2 613
Fluorescent tubes		0	26	23	26	28	27	35	33	29
Solvents	87	14	245	89	39	777	273	457	699	307
Paint, all types							0	80	108	235
Oily waste	162	145	2 544	2 447	2 031	6 810	2 288	6 438	8 499	10 508
Process-related waste								72	517	558
Cement									11	22
Spray cans	2	2	18	18	19	20	20	22	25	19
Tank washing waste	19	23	395	1 834	378	3 870	2 314	37 598	41 747	35 563

9 TERMS AND ABBREVIATIONS

CH_4	Methane
CO_2	Carbon dioxide
GHG	Greenhouse gas
NGL	Natural gas liquids
nmVOC	Non-methane volatile organic compounds
NO_x	Nitrogen oxides
SO_x	Sulphur oxides
SO_2	Sulphur dioxide
BAT	Best available technology
b/d	Barrels per day
LSC	Limit of significant contamination
oe	Oil equivalent
scm	Standard cubic metres
TCC	Thermomechanical cuttings cleaner
THC	Total hydrocarbon content
Vams	Video-assisted multi sampler

CCAC
Climate and Clean Air Act Coalition

EEH
Epim Environment Hub

ETS
EU emission trading system

IOGP
International Association of Oil and Gas Producers

NCS
Norwegian continental shelf

NEA
Norwegian Environment Agency

NPD
Norwegian Petroleum Directorate

VOCIC
VOC Industry Collaboration

Ospar
Oslo-Paris convention for the protection of the marine environment of the north-east Atlantic. Fifteen countries with coasts on or rivers emptying into these waters are signatories.

Plonor
"Pose little or no risk to the marine environment", a list from Ospar of chemical compounds considered to have little or no impact on the marine environment if discharged.

Conversion factors
based on the energy content in hydrocarbons. Calculated in accordance with definitions from the NPD:

Oil 1 cu.m = 1 scm oe
Oil 1 barrel = 0.159 scm
Condensate 1 tonne = 1.3 scm oe
Gas 1 000 scm = 1 scm oe
NGL 1 tonne = 1.9 scm oe

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