OSPAR COMMISSION

Denmark Assessment of Discharges, Spills and Emissions from Offshore Oil and Gas Installations in 2013 -17

Offshore Oil & Gas Industry Series

2019

Contents

Executive Summary

This report presents the discharge, spill and emission data from offshore oil and gas operations on Danish Continental Shelf (DCS) over the period 2013–2017 and the assessment of the data. The annual data is provided in the Appendix 2.

Level of Activity

The Danish Continental Shelf is a mature oil and gas province within the OSPAR region and production is declining. However, there is still a moderate level of oil and gas production, although this has decreased by almost 15 % in the reporting period from 2013 to 2017, which is partially due to shut down and refurbishment of some installations.

Discharges & spills

The total quantity of *dispersed*[1] *oil (aliphatic oil)* discharged to sea from produced water and displacement water fluctuated somewhat with a low of 162 tonnes in 2014 up to 200 tonnes in 2016 but overall remained fairly stable during the period of 2013–2017.

Produced water and displacement water discharges are the main contributors to the oil discharges from the petroleum industry. The total volume of produced water and displacement water discharged remained stable between 2013 and 2017.

A maximum of 2 installations on the DCS failed in 2015 to meet the performance standard for oil content as an annual average. The maximum amount of oil discharged with produced water exceeding the performance standard was 0,3 tonnes in 2015.

The total number of oil spills less than 1 tonne to sea increased to a high in 2014 but decreased thereafter during the period. The quantity of oil released was generally low but was unusually high in 2014 due to 3 incidents where larger quantities were spilled.

Chemicals

The total quantity of chemicals reported *used* offshore varied over the period. In 2013, 40.150 tonnes of chemicals were reported used. Of this, only 0,38 % belonged to the category “substitution chemicals”. 22 kg of chemicals on the OSPAR List of Chemicals for Priority Action (LCPA) were used in 2015 by one operator.

The total quantity of chemicals *discharged* into the sea over the period 2013 – 2017 varied slightly from approx. 13.300 tonnes to 15.900 tonnes. Of these chemicals only 0,07% belonged to the substitution chemicals category in 2013. This amount rose to 0,33 % in 2017 mainly due to DK re-classification of sodium hypochlorite. No LCPA substances were discharged during the period.

[1]. “Aliphatics” and “aromatics” are defined by the reference method set in OSPAR Agreement 2005-15 (Solvent extraction, Infra-Red measurement at 3 wavelengths). In that context, “aliphatics” and “dispersed oil” mean the same thing.

The number of smaller chemical spills to sea was relatively high although the quantity of chemicals spilled decreased during the period from 2013 to 2017. The number of larger spills remained low but there was a peak in the quantity spilled in 2015 due to a specific incident at one installation.

Atmospheric Emissions

Atmospheric emissions are not regulated by OSPAR measures, but they are reported annually to OSPAR. There was a downward trend between 2013 and 2017 for the atmospheric emissions of CO_2 while the emission of nmVOC and methane were fairly stable during the period. Emissions of sulphur dioxide and NOx fluctuated with a peak in 2016 but subsequently went down to a low in 2017.

Récapitulatif

Le présent rapport comporte des données portant sur les rejets, déversements et émissions provenant des activités pétrolières et gazières offshore sur le plateau continental danois (DCS) entre 2013 et 2017 ainsi que leur évaluation. Les données annuelles se trouvent dans l'appendice 2.

Niveau d'activité

Le plateau continental danois est une région pétrolière et gazière arrivée à maturité de la zone OSPAR et la production est en déclin. Cependant, un niveau moyen de production pétrolière et gazière subsiste, bien qu'elle ait diminué de presque 15 % au cours de la période de notification de 2013 à 2017. Ceci est dû en partie à la fermeture et à la remise en état de certaines installations.

Rejets et déversements

Le volume total d'*hydrocarbures dispersés*[2] *(hydrocarbures aliphatiques)* rejetés en mer, provenant de l'eau de production et de l'eau de déplacement, varie légèrement allant de 162 tonnes en 2014 à 200 tonnes en 2016. Cependant, elle demeure relativement stable dans l'ensemble entre 2013 et 2017.

Les rejets d'eau de production et d'eau de déplacement sont les principaux contributeurs aux rejets d'hydrocarbures provenant de l'industrie pétrolière. Le volume total d'eau de production et d'eau de déplacement rejetées demeure stable entre 2013 et 2017.

En 2015, au maximum deux installations sur le DCS ne répondaient pas aux normes de performance en ce qui concerne les teneurs en hydrocarbures au niveau de la moyenne annuelle. La quantité maximum d'hydrocarbures rejetés avec l'eau de production dépassant les normes de performance s'élevait à 0,3 tonnes in 2015.

Le nombre total de marées noires inférieures à une tonne a culminé en 2014 mais a ensuite diminué au cours de la période. La quantité d'hydrocarbures déversés a été faible dans l'ensemble mais exceptionnellement élevée en 2014, trois incidents étant responsables de déversements plus importants.

[2]. Les hydrocarbures « aliphatiques » et « aromatiques » sont définis par la méthode de référence énoncée dans l'Accord OSPAR 2005-15 (Extraction par solvant, mesure par infrarouges à 3 longueurs d'onde). Dans ce contexte, les termes « hydrocarbures aliphatiques » et « hydrocarbures dispersés » ont le même sens

Produits chimiques

La quantité totale de produits chimiques utilisés offshore notifiée a varié au cours de la période. On a notifié en 2013, 40.150 tonnes de produits chimiques utilisés, dont 0,38 % seulement appartiennent à la catégorie « produits chimiques de substitution ». Un opérateur a utilisé, en 2015, 22 kg de produits chimiques figurant sur la Liste OSPAR des produits chimiques devant faire l'objet de mesures prioritaires (LCPA).

La quantité totale de produits chimiques *rejetés* en mer entre 2013 et 2017 a légèrement varié, allant d'environ 13.300 tonnes à 15.900 tonnes. Seulement 0,07% de ces produits chimiques appartiennent à la catégorie produits chimiques de substitution en 2013 mais 0,33 % en 2017 ce qui a été dû essentiellement au reclassement de l'hypochlorite de sodium par le Danemark. Aucun produit chimique de la LCPA n'a été rejeté au cours de la période.

Le nombre de marées noires plus petites a été relativement élevé bien que la quantité de produits chimiques déversés ait diminué entre 2013 et 2017. Le nombre de marées noires plus grandes demeure faible mais les quantités déversées ont culminé en 2015, un incident spécifique s'étant produit dans une installation.

Emissions atmosphériques

Les émissions atmosphériques ne sont pas réglementées par les mesures OSPAR mais elles sont notifiées tous les ans à OSPAR. On a relevé une tendance à la baisse des émissions atmosphériques de CO_2 entre 2013 et 2017 alors que les émissions de nmVOC et de méthane ont été raisonnablement stables au cours de la période. Les émissions de dioxyde de soufre et de NOx varient, elles ont culminé en 2016 mais ont ensuite atteint un minimum en 2017.

1. Introduction

This report provides an assessment of the discharges, spills and emissions to the North Sea from offshore oil & gas exploration and production installations on the Danish Continental Shelf (DCS) during the period 2013–2017. The purpose of the report is to assess trends related to the effectiveness of the OSPAR measures and the national regulation. Trends have been assessed using expert judgement and not by statistical analyses.

The assessment is based on data submitted by the operators on the DCS to the Danish Environmental Protection Agency (DEPA) and reported by Denmark in the annual OSPAR report on discharges, spills and emissions from offshore oil and gas installations. The assessment is based on the data available at the time when the annual OSPAR report was submitted (see the Data Annex).

Where relevant, the performance on the DCS has been compared to the overall performance in the OSPAR area, using the following source:

- "Draft OSPAR report on discharges, spills and emissions from offshore oil and gas activity in 2017" (EAP meeting 2019)

This report does not seek to assess the impact on the environment of these discharges, spills and emissions.

It should be noted that Denmark is a medium to small sized oil and gas producer in the OSPAR region. Emissions and discharges on the DCS therefore only contribute to a small degree to the total emissions and discharges in the North Sea area. As OSPAR trends in performance are mainly driven by the larger oil and gas producing countries in the North Sea area, making a comparison of performance is challenging.

The operators have used procedures for sampling and analysis detailed by the Danish Environment Protection Agency (DEPA), and quality assurance procedures described by DEPA. Certified laboratories have been used.

2. Setting the scene

Measured in total oil equivalents (toeq) Denmark was by 2017 the third largest producer of oil and gas in the OSPAR region, although its share is only about 4 % of the total production. The DCS is a maturing basin, and production on the DCS has been declining since 2004. The decline has continued in the period 2013 – 2017 with a 15 % decrease in production since 2013.

Figure 1 shows the official Danish production data in tonnes of oil equivalents.

The number of installations with discharges and emissions has increased from 14 to 21. The change, however, is mainly due to the way production installations are reported by some of the operators. The increase by one installation in 2017 was due to a new operator commencing production.

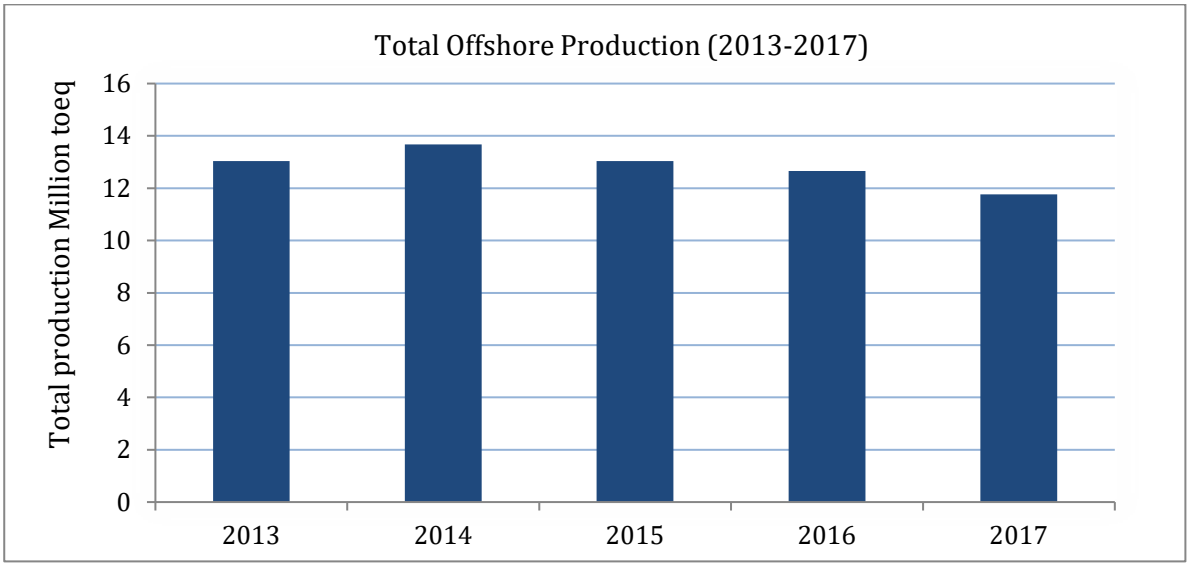


Figure 1: Annual total production of oil equivalents on the Danish Continental Shelf

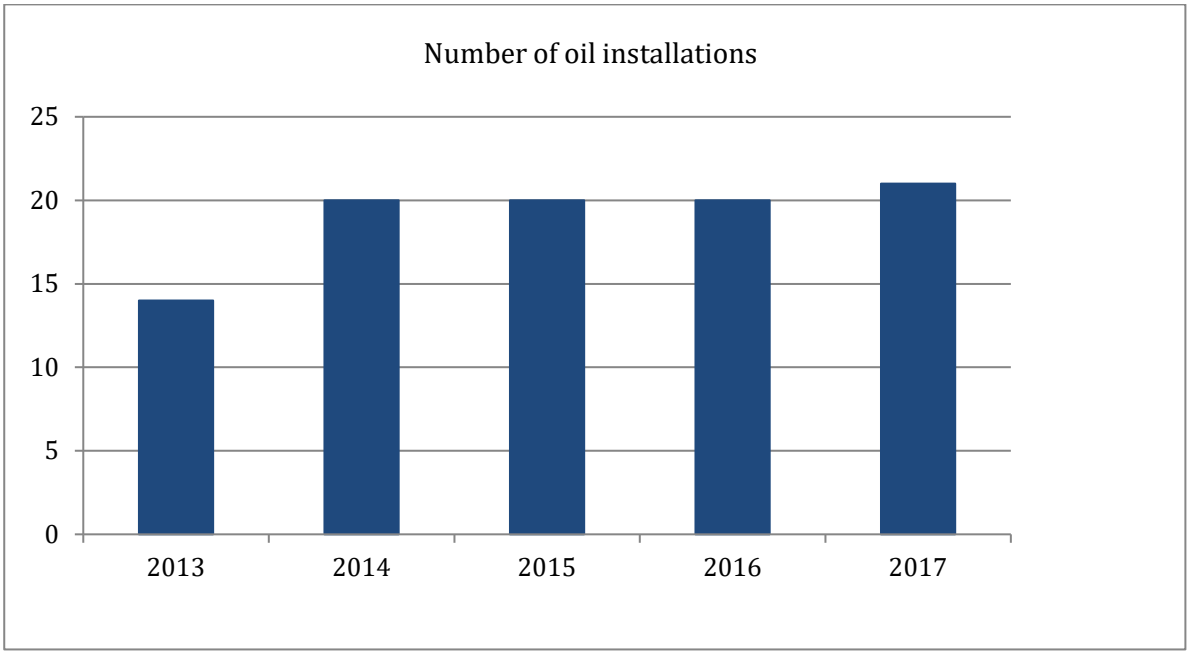


Figure 2: Number of installations on the Danish Continental Shelf

The reported number of wells drilled on the DCS decreased between 2016 and 2017, as shown in Figure 3. The variation in the number of wells between 2013 and 2017 shows no general trend.

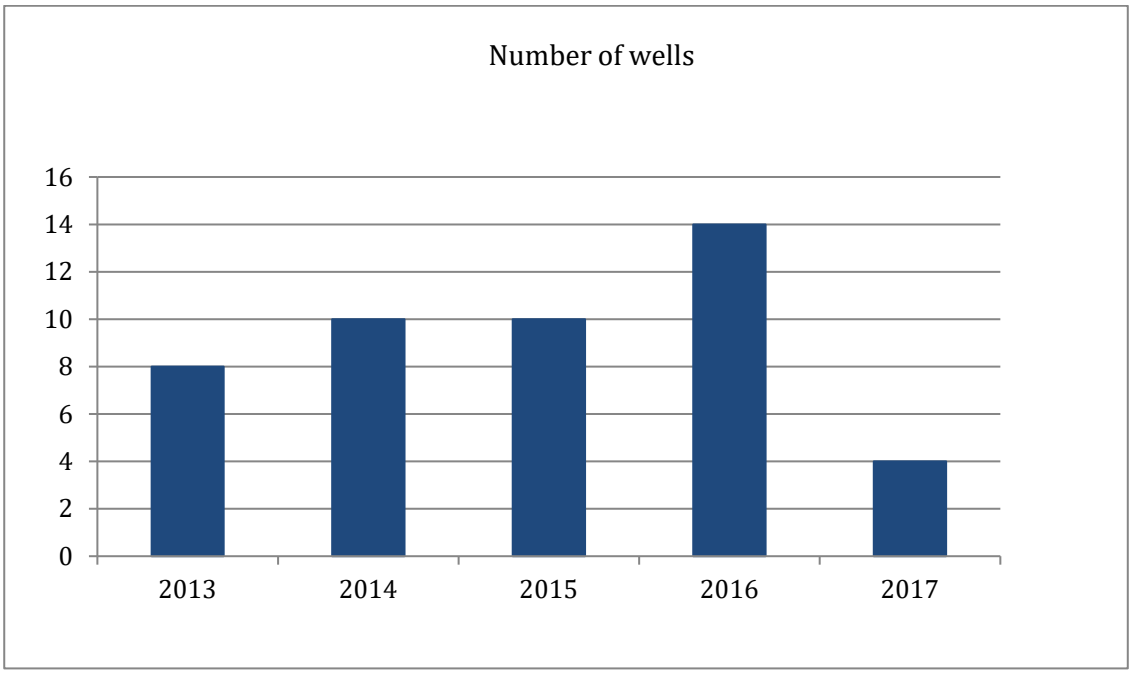


Figure 3: Number of wells drilled on the Danish Continental Shelf 2013 - 2017

3. Environmental Management

In accordance with OSPAR Recommendation 2003/5 to Promote the Use and Implementation of Environmental Management Systems (EMS), the offshore action plan of 2005 agreed between the Danish offshore operators and the Ministry of Environment comprised the goal that all operators by 2006 should establish EMS that should be ready for certification or other similar scheme. The EMS should cover both the production and exploration activities of the individual operator. Based on this agreement the four current Danish operators with production activities in the DCS have established EMS in accordance with the ISO 14001 standard and subsequently these have been certified. The operators prepare annual environmental reports that are made available to the public. DEPA does not issue formal approvals related to the operator's EMS, but DEPA's inspections both on- and offshore also includes examination of relevant parts of the EMS. In addition, the discharge permits include requirements for the operators to conduct at least one annual independent verification of the Oil in Water sampling, analysis and reporting procedures and of the procedures related to the measurements of the flow of produced water discharged to the sea or re-injected including procedures for maintenance and calibration of flow meters.

4. Oil discharges

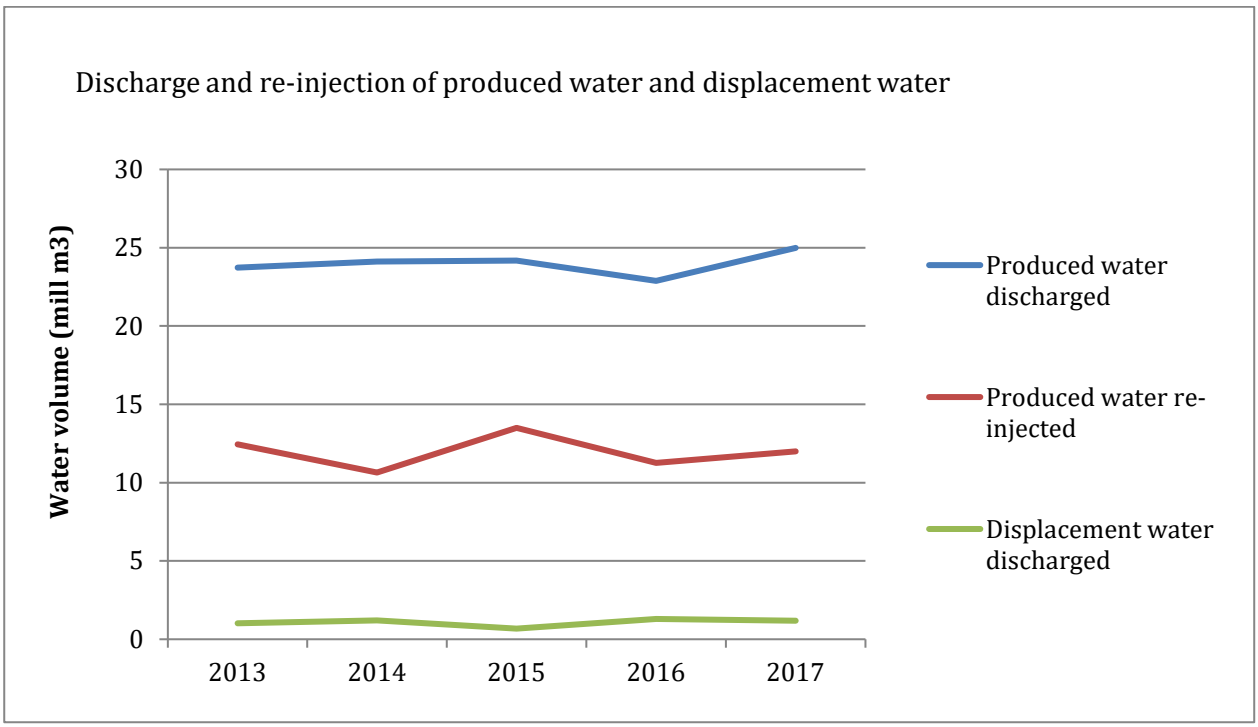
4.1. Discharges of oil to sea

Discharges of dispersed oil are regulated in accordance with OSPAR Recommendation 2001/1 (as amended). The permits for discharge of produced water include a condition that the oil content as a monthly flow weighed average must not exceed 30 mg dispersed oil per litre of produced water discharged to the sea or re-injected. The limit value is waived if the total discharge of dispersed oil over the last 12 months (rolling total) has been below 2 tonnes.

Produced water and displacement water

The total volume of produced water generated on the DCS has decreased by 5 % from 2013 – 2017 due to decreasing overall production volumes, however produced water discharges increased by about 5 % from 2013 to 2017 (Figure 4). From 2013 to 2017 the discharges of displacement water has increased by 17 %. The volume of re-injected produced water decreased by 4 % between 2013 and 2017. The increase in production water discharged to sea is related to a lower volume of re-injection in the period.

Figure 4: Discharges and injection of produced water and displacement water on the DCS 2013—2017



Comparing this with OSPAR overall figures shows that:

- The discharge of water on the DCS have increased by approximately 5% over the last reporting period. In the OSPAR area as a whole, the change has been negligible.
- The discharges of displacement water increased by 17 % on the DCS in the reporting period, whereas the figure for OSPAR in general was stable for most of the period, although the figure in 2017 was down by almost 10 % compared to the year 2013.
- The produced water re-injected in DCS varied in the reporting period, from 13,5 to 10,6 mil. m^3/year but no clear trend can be drawn.

Dispersed oil discharged

The total quantity of dispersed oil discharged with produced water and displacement water went from 178 to 170 tonnes which is a 4 % decrease in the period (Figure 5). However the discharges were 190 tonnes and 200 tonnes in 2015 and 2016 respectively. This was due to challenges with re-injection and management of water treatment during start-ups. The OSPAR goal of reducing the discharges of dispersed oil with produced water to 85 % of the level in 2000 was reached in 2010. The 85 % level, which on the DCS is equal to 222 tonnes, has since then been set as the national yearly maximum for the total discharge of dispersed oil allowed on the DCS from all the offshore oil and gas activities (named “the national ceiling”). Within this framework the individual discharge permits contains conditions on how much of the 222 tonnes of dispersed oil the individual operators are allowed to discharge to the sea each year.

The dispersed oil discharged with produced water accounted for more than 99 % of the total amount of oil discharged and for some years it was 100%. The average dispersed oil concentration in produced water and displacement water, was in the same period fairly stable around 7 mg/l, but with higher concentrations in 2015 and 2016 (Figure 5).

The figures for the dispersed oil concentration in produced and displacement water in the OSPAR area vary, and no temporal trend can be observed over the 2013 – 2017 period. The average concentration in 2017 of oil in produced water on the DCS was significantly lower than the average concentration in the OSPAR area (6,8 mg/l and 13,1 mg/l, respectively).

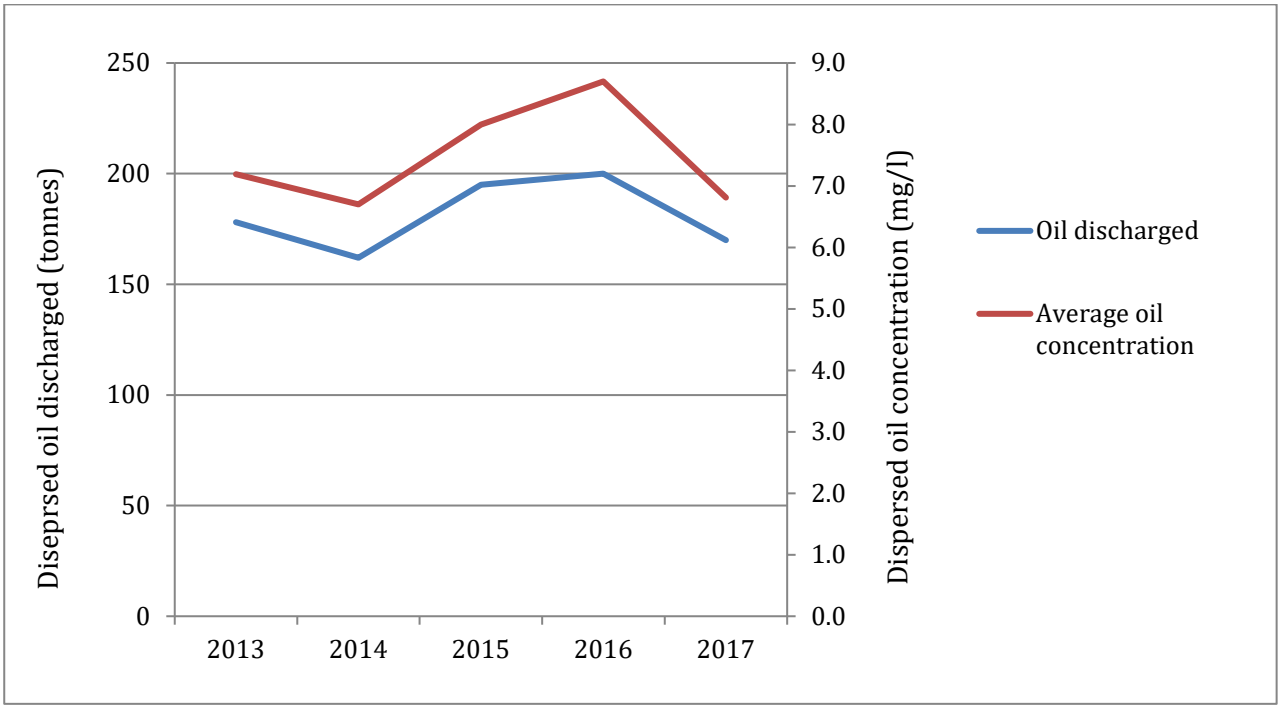


Figure 5: Quantity and concentration of dispersed oil discharges 2013—2017

Recommendation 2001/1 sets a performance standard for the discharge of dispersed oil in produced water. Since 2007 OSPAR has set the performance standard at 30mg/l. For regulatory purposes in the DCS this is calculated as a monthly flow weighted average irrespective of the number of samples taken per day. However, for comparison within OSPAR an annual average is used.

As can be seen from Figure 6 two installations failed to meet the 30 mg/l annual average dispersed oil concentration in 2015 while there was only one in 2014. One of the installations in 2015 had an unusual number of shutdowns, which caused upsets in the produced water treatment. The other installation accounting for not reaching the goal in 2014 and 2015 was due to re-injection issues where small quantities of water with relatively high concentrations of dispersed oil was discharged. The operator informed DEPA that they always prioritize to maintain the highest possible re-injection rate to reduce the total amount of produced water discharged, even though this in turn will imply a risk of exceeding the monthly limit value of 30 mg/l. DEPA agrees to this approach as the amount of produced water discharged is very limited, because the operator complies with the rolling 12 month total maximum discharge of 2 tonnes of dispersed oil discharge and as the re-injection is coupled with continuous efforts to reduce the oil concentration in the produced water.

The quantity of dispersed oil discharged by installations that failed to meet the performance standard is generally very low in the DCS and was 0 tonnes in 2013, 2016 and 2017. The highest amount recorded in the period was 0,3 tonnes in 2015.

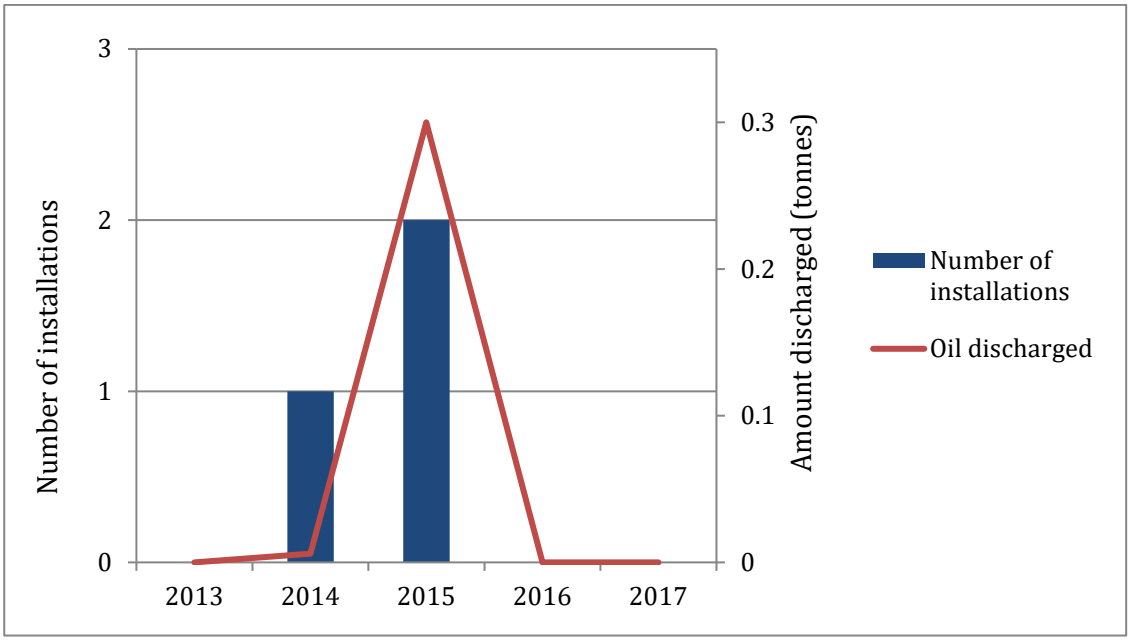


Figure 6: Installations failing to meet performance standards for concentration of oil in water discharged and amount oil discharged because of the excess in concentration

Denmark also reports the dissolved oil content (as represented by BTEX components) in produced water discharges. OSPAR has not issued recommended discharge levels for these components as they rapidly biodegrade in seawater once discharged. The discharge of dissolved oil[3] (BTEX) in produced water has in the period from 2013 to 2016 shown values ranging from 89 to 145 tonnes. There was an unusually high value of 275 tonnes in 2017, which the operator advised was due to technical issues in the laboratory where the sample was analyzed. Over the period 2013 to 2017 the discharges of BTEX has varied from year to year and no clear-cut trend can be identified.

4.2. Risk-based Approach (RBA)

In 2012 OSPAR adopted Recommendation 2012/5 for a risk-based approach to the management of produced water discharges from offshore installations. Denmark has implemented the Recommendation in 2018 and has issued specific requirements in the permits for the installations discharging produced water. DEPA received the final RBA reports from the Danish offshore operators in January 2018 including calculated field specific Environment Impact Factors (EIFs). A Danish manual for undertaking and reporting the RBA calculations was produced and finalised in September 2018 based on experiences from RBA calculations for all of the discharge points. Requirements for RBA was incorporated into the Danish permits for discharge of produced water in late 2018, effective from 1. January 2019.

4.3. Spills of oil to sea

The total number of oil spills to the sea has varied in the DCS between 2013 and 2017, with a high of 77 spills in 2015 and a low of 36 in 2017. The vast majority of the spills were much smaller than 1 tonne.

[3] "Aliphatics" (or "dispersed oil") are regularly and frequently measured, while the sampling is much less frequent for "aromatics". Therefore data on "aromatics" may be less reliable.

The quantity of oil released has, as expected, shown larger variations, since it is mainly driven by the small and variable number of spills larger than 1 tonne. In 2014 three larger spills contributed with total amount of 45 tonnes of oil. The main contributor was due to a leak in a diesel tank, which accounted for 34 tonnes of diesel oil spilled to the sea.

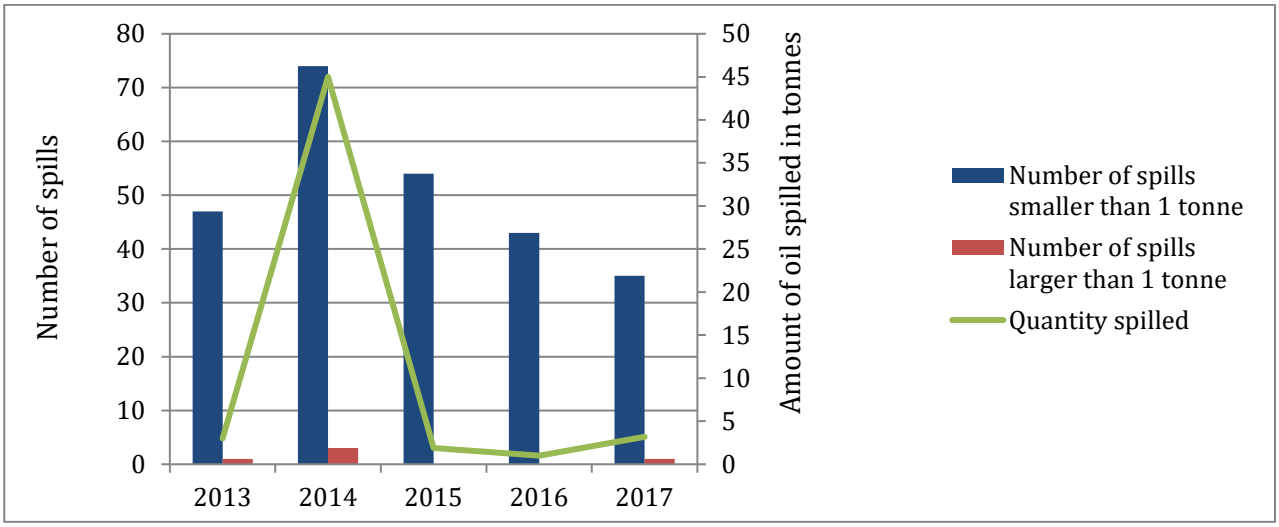


Figure 7: Number of oil spills and total quantity of the spills on the DCS 2013—2017

Comparing figures from DCS to overall figures from OSPAR indicates the following:

- Between 2013 and 2017 there was a decrease in number of oil spills, however there is considerable variation from year-to-year. The same conclusion can be said about the data from the OSPAR area.
- Between 2013 and 2017, the quantities of oil spilled were fairly stable, however there was a peak in 2014 due to 3 larger spill-incidents. Large variations in both the number and quantity of the spills from year to year across the OSPAR area however, make a genuine comparison difficult.

4.4. Discharges of organic phase fluids

Discharge of cuttings contaminated with organic phase fluids (OPF) at a concentration greater than 1% by weight on cuttings is prohibited based on OSPAR Decision 2000/3. Denmark regulates this through conditions in the discharge permits. Although some technologies are able to reduce the concentration of oil to below the 1 % limit, no cuttings contaminated with OPF were discharged on the DCS between 2013 and 2017.

5. Chemicals

5.1. Chemical Use & Discharge

In this document, the following applies:

The term *substitution chemical* is short for *chemicals which contain one or more substances which are candidates for substitution*, according to OSPAR Recommendation 2010/4.This includes chemicals which are

- on the OSPAR LCPA,
- inorganic with LC_{50} or EC_{50} less than 1 mg/l,
- have biodegradation less than 20 %, or
- meets two of three criteria:
  - biodegradation less than 60 %,
  - BCF larger than 100 or Log $P_{ow} \geq 3$, or
  - LC_{50}/EC_{50} less than 10 mg/L.

Chemicals that are considered to 'Pose Little or No Risk' to the environment are referred to as PLONOR chemicals. Chemicals that are considered to be PLONOR are detailed on the OSPAR PLONOR list.

Chemicals that are neither PLONOR nor candidates for substitution include those that are:

- Inorganic with LC50 or EC50 greater than 1 mg/l,
- Ranking chemicals, which includes substances ranked according to OSPAR Recommendation 2000/4 and which do not fall into another category.

The goal of OSPAR Recommendation 2006/3 is that discharges of substitution chemicals should be phased out by 2017. In addition OSPAR Recommendation 2005/2 set a goal that Contracting Parties should have phased out the discharge of substitution chemicals on the OSPAR 2004 List of Chemicals for Priority Action (LCPA) by 1 January 2010. There are no OSPAR measures against the other categories of chemicals classified within the Harmonised Mandatory Classification System, as these are deemed not to pose a significant risk to the environment.

On the DCS all use and discharge of offshore chemicals (except for emergency use) requires a permit. The permit reflects the amount of chemicals the individual operators have applied to use and discharge per year in the period of the granted permission. The offshore operators on the DCS stopped all discharges of LCPA chemicals by 2004. The plan also stipulates that the discharge of other substitution chemicals should be phased out by the end of 2008. There has been no discharge of LCPA chemicals in the reporting period from 2013 to 2017. On the other hand, the quantity of discharged inorganic substances with LC50 or EC50 < 1 mg/l, has increased due the fact, that Denmark re-classified the product sodium hypochlorite in 2016 to be a substitution chemical due to its intrinsic toxic properties.

As none of the operators applied for discharge of substitution chemicals in connection with the renewal of their discharge permits by January 2013, DEPA decided to include a general condition in the permits prohibiting discharge of such chemicals. Discharge of substitution chemicals is now only acceptable if an

evaluation carried out by the operator shows that the discharge of the substitution chemical - apart from being the best solution technically and in regard to safety - is also from an environmental point of view the best solution. The operator shall also document that alternative offshore chemicals have been evaluated.

The choice, evaluation and ranking of offshore chemicals is the operator's responsibility. DEPA examines the characteristics of the individual offshore chemicals through the pre-screening forms compared with the HONCF forms, which are retrieved through the Danish Product Registry.

DEPA lists offshore chemicals approved for use and discharge, according to the categories of offshore chemicals, that is, a) Ranking category (termed “yellow chemicals”) and b) PLONOR chemicals and inorganic substances not containing substitution chemicals (termed “green chemicals”). The listing however is only carried out for offshore chemicals that the operators have applied to use and discharge.

These common (and as such identical) lists are part of the discharge permits given to the individual operators, who can use and discharge all the chemicals on the lists. However, if an offshore chemical on the lists was not originally included in the application from an individual operator, the operator is required to inform DEPA, when they want to use and discharge such a chemical and also inform DEPA, if the chemical replaces another chemical, that was included in the original application. A new permit though is not required. If the operator wants to use and discharge an offshore chemical not on one of the two lists, an application to DEPA is required. In principle DEPA does not limit the amount of yellow and green offshore chemicals used or discharged.

The total amount of offshore chemicals used fell by 9,3 % between 2013 and 2017, although fluctuations were seen with a maximum of approx. 68.500 tonnes in 2016 and a low of 36.400 tonnes in 2017. On the other hand, the discharge of chemicals increased by 19 % from 2013 to 2017 (Figure 8).

The increase in use of chemicals in 2016 is mainly due to higher drilling activities in that particular year.

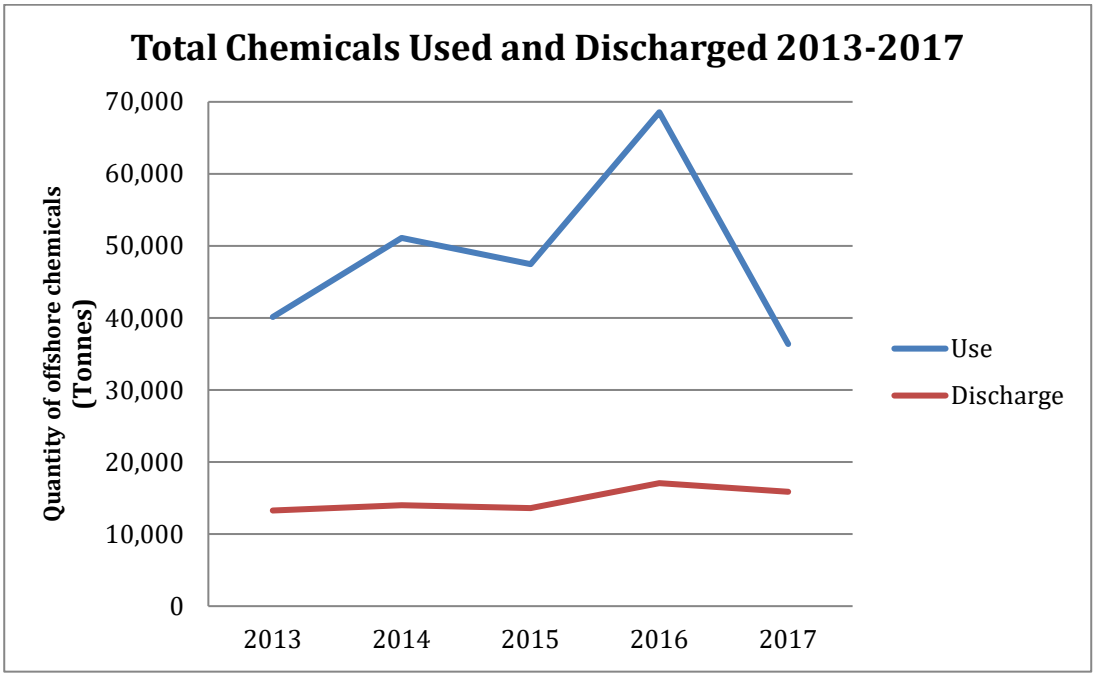


Figure 8: Total quantity of offshore chemicals used and discharged on the DCS 2013—2017

Chemicals Used

The total quantity of chemicals *used* on the DCS in 2017 was approx. 36.400 tonnes out of which 65,1 % were chemicals on the PLONOR list and approx. 34,8 % (wt.) were other non-substitution chemicals (Figure 9). In the same year (2017) use of substitution chemicals represented approx 0,1 % of the total use on the DCS (Figure 10). 22 kg of chemicals on the LCPA list was used in 2015, but no discharge occurred.

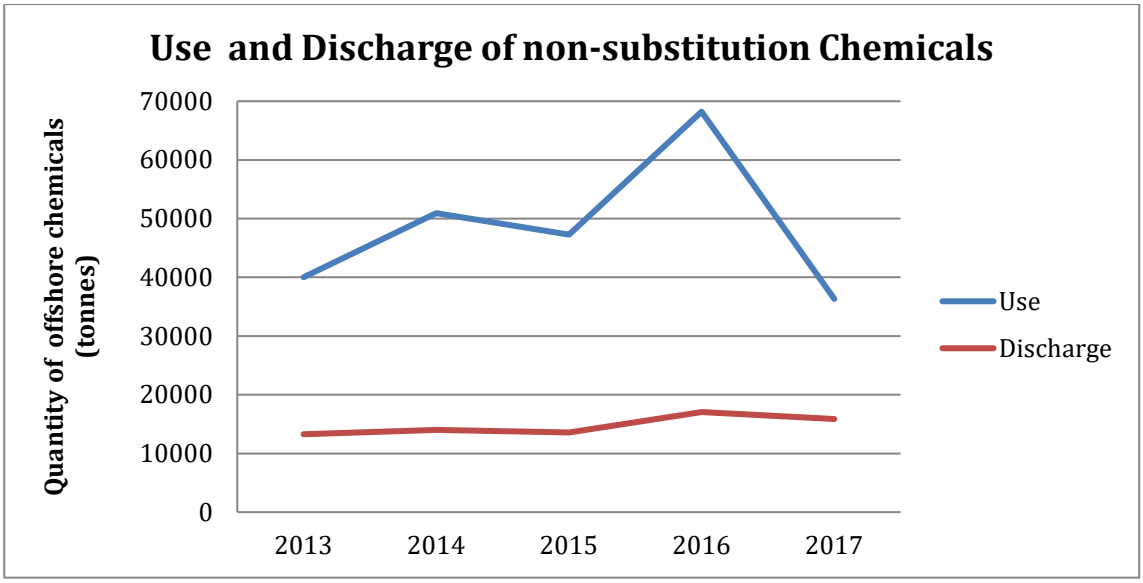


Figure 9: Quantities of chemicals not containing substitution candidates used and discharged 2013—2017

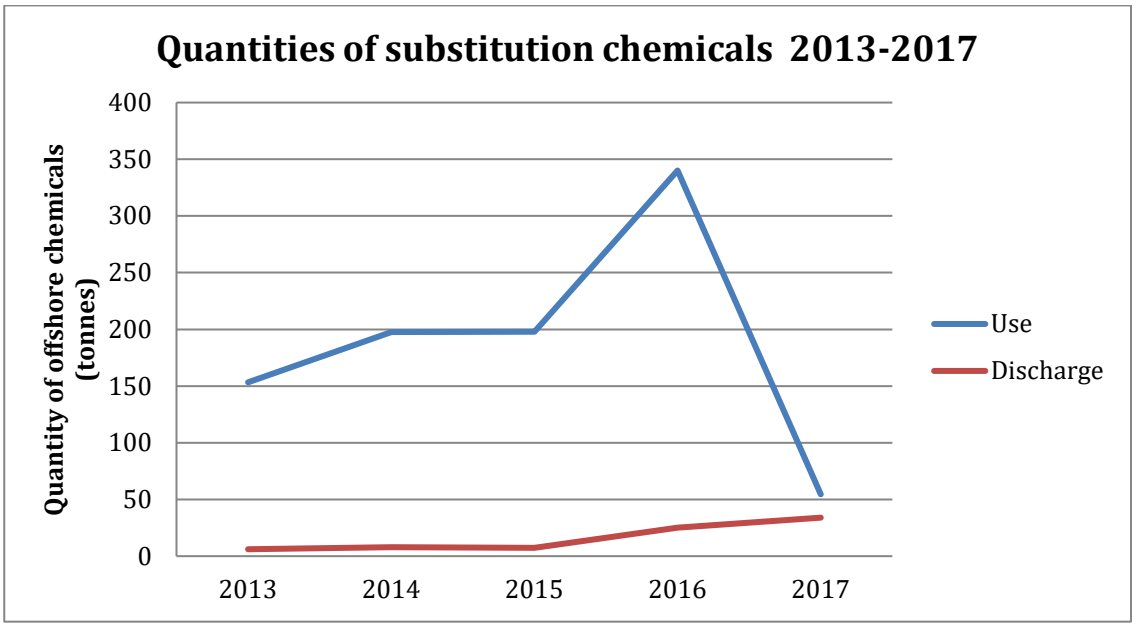


Figure 10: Quantities of substitution chemicals (except LCPA chemicals) used and discharged 2013—2017.

The peak in the use of substitution chemicals in 2016 is based on an increase in use of drilling chemicals. A lesser contribution to the peak in the graph is also due to reporting of sodium hypochlorite, which was re-classified in Denmark in 2016 to be a substitution chemical. The smaller increase in discharge of substitution chemicals from 2015 reflects the reported discharge of sodium hypochlorite.

According to OSPAR documents, the figures for 2017 demonstrate that almost 70 % of chemicals used were on the PLONOR list, 29 % were other non-substitution chemicals and approx. 1 % was substitution chemicals. Use of LCPA chemicals was negligible. Thus,

- the percentage of PLONOR chemicals used in 2017 was 5 % lower on the DCS in 2017 than the average in the OSPAR area in 2017, while
- the percentage of other non-substitution chemicals used (approx. 35 %) was a little higher on the DCS compared to the OSPAR area (approx. 29 %), and
- the percentage substitution chemicals used was somewhat lower on the DCS (0,1%) than in the entire OSPAR area (1 %).

Chemicals Discharged

The total quantity of chemicals *discharged* to the sea on the DCS in 2017 was 15.871 tonnes. Approximately 63,7 % of these were listed on the PLONOR list. Thirty six per cent (36%) of the chemicals discharged were other non-substitution chemicals and the remaining approx. 0,3% were substitution chemicals.

According to OSPAR, the corresponding overall figures for 2017, demonstrates that 79 % of the chemicals discharged were on the PLONOR list, 20,5 % made up for other non-substitution chemicals and less than 1 % of the chemicals were substitution chemicals.

Thus,

- the percentage of PLONOR chemicals discharged on the DCS was lower in 2017 than the average in the OSPAR area in 2017, while
- the percentage of other non-substitution chemicals discharged was higher on the DCS,
- the reported percentage of substitution chemicals discharged on the DCS was comparable to the OSPAR area as a whole.

5.2. Chemical Spills

The number of chemical spills to the sea in the reporting period was characterized by a large spill greater than 1 tonne in 2015 by one of the operators. The operator has reported the spill as being Oil Based Mud (OBM) which occurred during a transfer from the rig to the supply boat. The number of spills < 1 tonne varied between a maximum of 38 in 2015 to a low 25 in 2017 (Figure 11).

The amount of chemicals spilled through these spills did however, not increase similarly as the average size of the spills remained low in the period. There is no clear trend in the amount of chemicals spilled per year, apart from that the number of spills larger than 1 tonne and quantity of spills smaller than 1 tonnes remained fairly low.

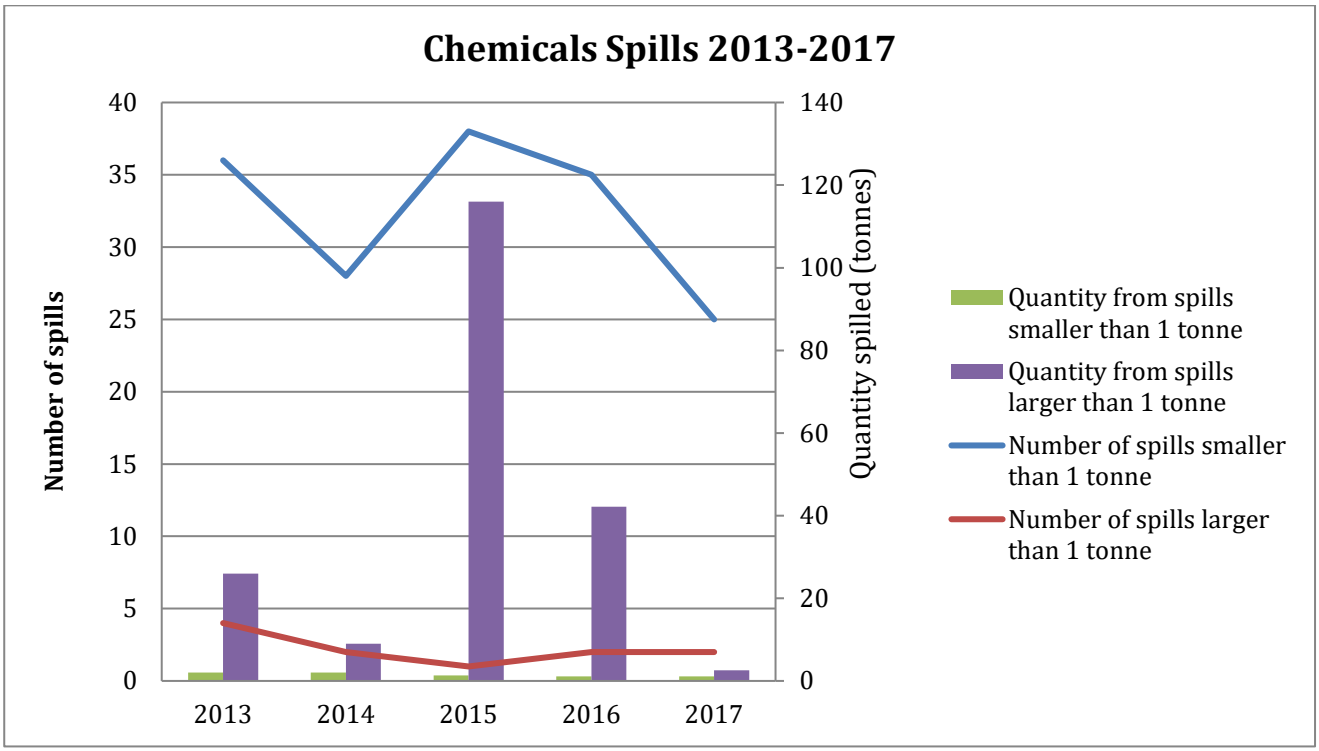


Figure 11: Number and quantity of chemical spills on the Danish Continental Shelf 2013—2017

In the OSPAR area there seems to be no clear trend in both the number of spills and the amount spilled as the data varies from year to year, except that the variation in quantity of the larger spills varies by more than 100% from selected years in the reporting period, whereas the number of spills remain fairly stable.

Consequently,

- there is no clear tendency for the number of smaller and larger spills on the DCS which is similar to the trend in the OSPAR area,
- there is no clear trend in the quantities spilled on the DCS, within the reporting period and the same goes for the data for the OSPAR area as a whole.

6. Emissions to air

Atmospheric emissions are not covered by OSPAR measures or harmonised OSPAR measurement methodologies, but the reporting of these emissions is part of the annual reporting to OSPAR that is a requirement in the discharge permits issued by DEPA.

Of the atmospheric emissions reported to OSPAR the emissions of NO_x from the offshore combustion plants (the LCPs) are regulated through approvals of the plants according to the Danish Act on Environmental Protection. In addition, the operators have since 2010 been paying an emission tax. Since 2016 the tax has been 5 DKK/kg NO_x emitted.

Atmospheric emissions of CO_2 are regulated through the Danish CO_2 allowance scheme[4], as the emissions are reported annually to the Danish Energy Agency (DEA).

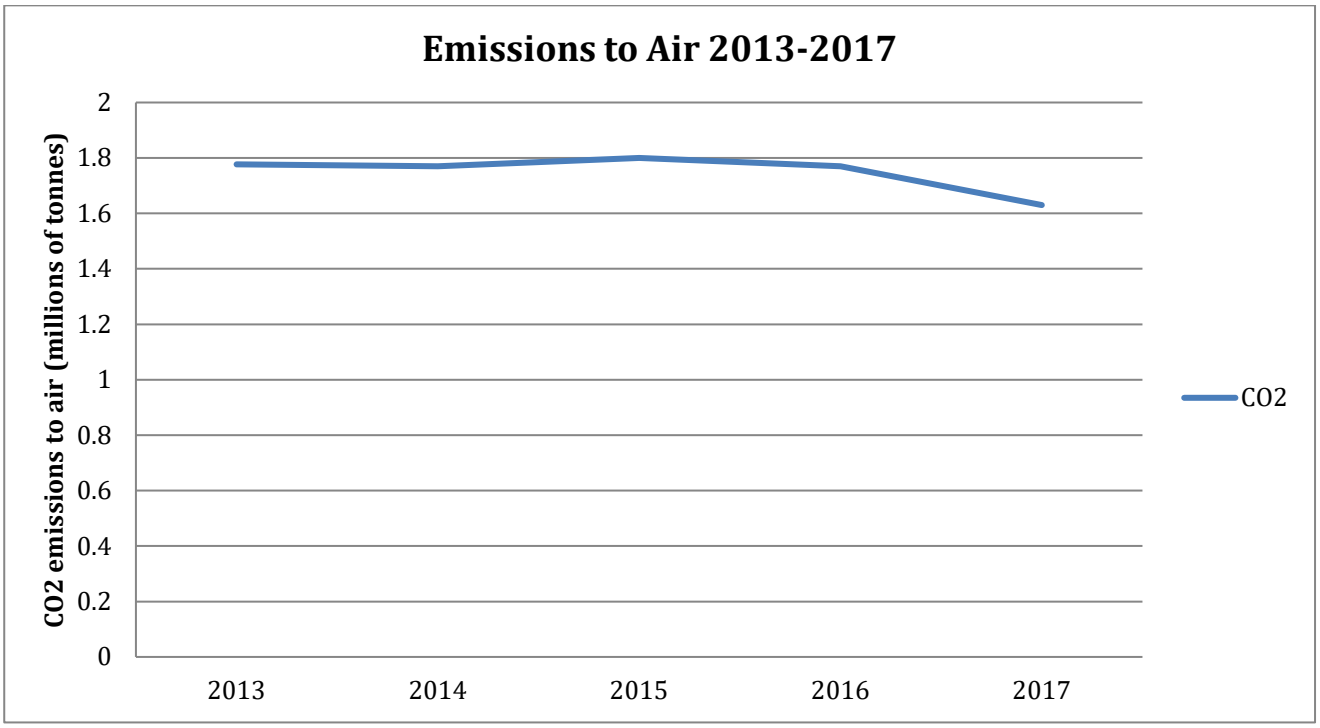


Figure 12: Emissions of CO2 on the Danish Continental Shelf 2013—2017

There was a general downwards trend between 2013 and 2017 for the atmospheric emissions of CO_2 on the DCS (Figure 12).

[4] According to Directive 2003/87/EC of the European Commission and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.

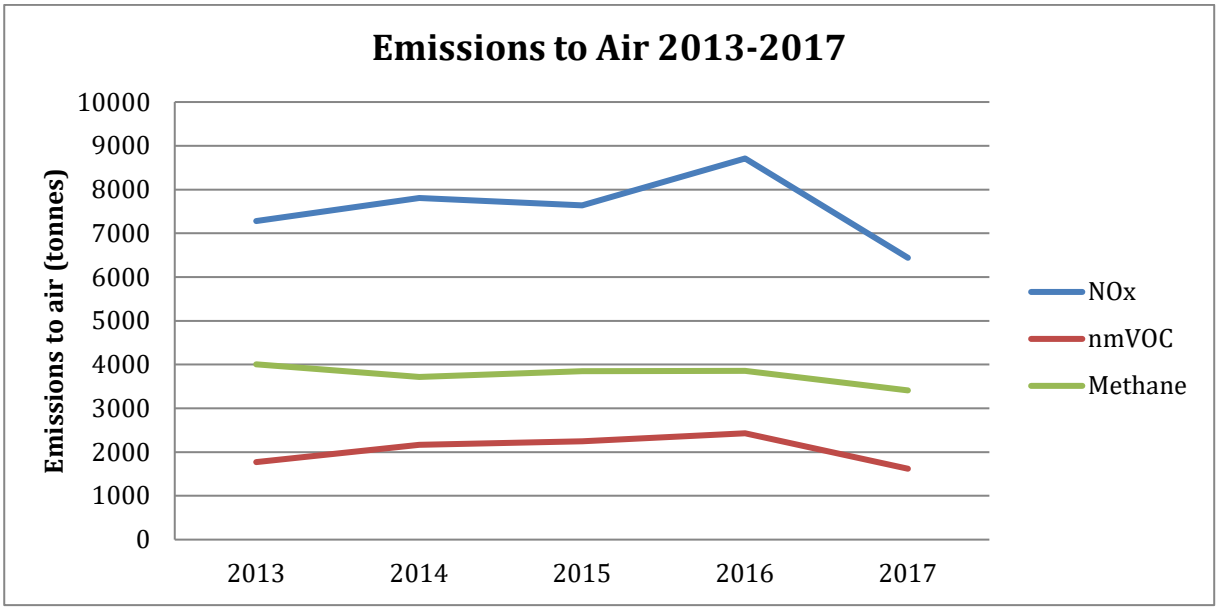


Figure 13: Emissions of NOx, methane and nmVOC on the Danish Continental Shelf 2013—2017

A similar downward trend was found for the emissions of Methane (Figure 13). For NOx and non-methane VOC the levels of emissions increase from 2014-2016 and then drop again. The changes in emissions are mainly driven by the level of drilling activity.

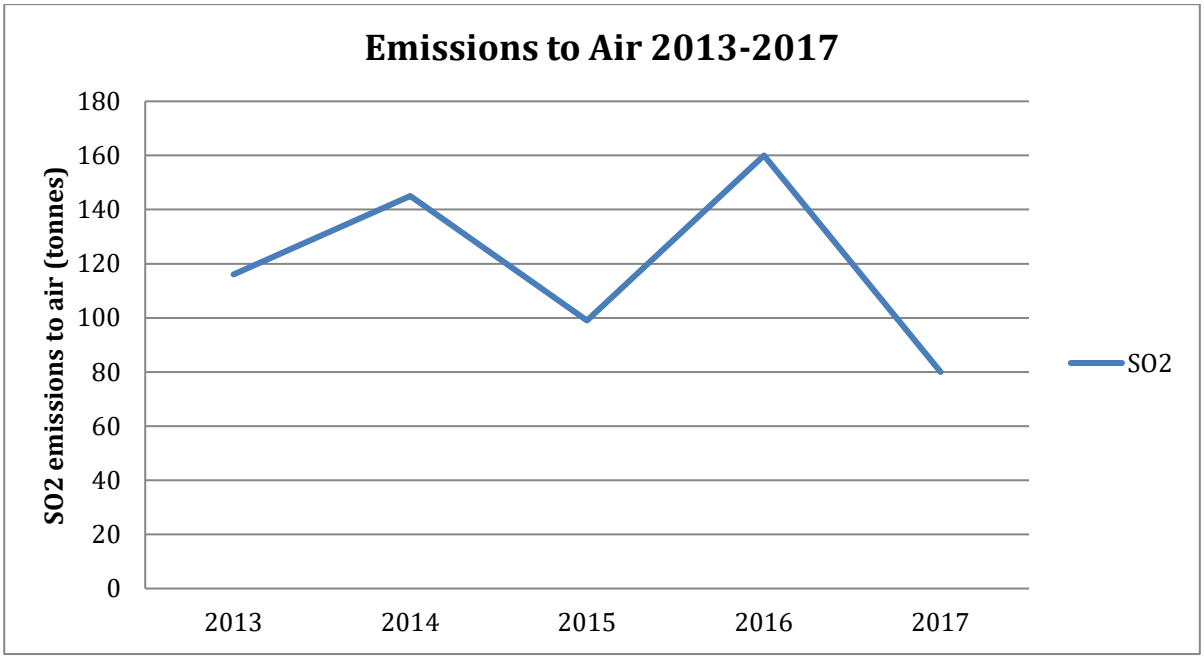


Figure 14: Emissions of SO2 on the Danish Continental Shelf 2013—2017

Emissions of sulphur dioxide follows the pattern of NOx and fluctuated with a peak in 2016 but subsequently went down to a low in 2017. The reason for the increased emission of SO2 in 2016 is to be seen in conjunction with increase in drilling activities.

7. QA procedures in Denmark

7.1. Counting of installations

In OSPAR, the number of installations is detailed in the "Inventory of oil and gas offshore installations in the OSPAR maritime area ". The number of installations reported annually to OIC, as reflected in Table 2 of the present report, only comprises installations with discharges to the sea and emissions to air.

7.2. Reporting of dispersed oil

In Denmark operators are required to both quantify the amount of produced and displacement water discharged and to determine the concentration of dispersed oil in the discharge.

The concentration of dispersed oil is determined by sampling the discharge stream on a routine basis and analysing the samples in accordance with the requirements in the discharge permits based on OSPAR Recommendation 2001/1. Operators are required to sample discharge streams once per day and within the same 1-hour time interval each day. If more samples are taken (normally only relevant for discharges of produced water), the concentrations of dispersed oil in all the samples are to be reported in the monthly discharge reports to DEPA, but only the concentration value from the first sample are included in the calculation of the monthly weighed concentration average and in turn in the calculation of the total amount of oil discharged for that month. This procedure is valid during stable operational conditions, meaning that only few and smaller fluctuations in the oil concentration are registered through the online oil in water monitor.

If there is a risk of unstable operating conditions (see list below) or if bigger fluctuations in the oil concentration or concentrations of dispersed oil in the produced water above 100 mg/l are registered through the online monitor, the operator is required to initiate sampling of the produced water 3 times per day at an 8 hourly interval. The increased sampling frequency shall be continued until 3 subsequent samples show a concentration of dispersed oil below 20 mg/l. A weighted daily average concentration of dispersed oil is calculated based on the 3 individual concentrations multiplied by the amount of produced water discharged from the time of the first the sample and until the 2nd and 3rd samples respectively are taken.

The increased sampling frequency has to be started in advance of the initiation of activities that potentially can lead to unstable operating conditions. If this is not possible due to e.g. a shutdown of the discharge of produced water to the sea, the increased sampling frequency should be restarted when the discharge is resumed.

Unstable and potentially unstable operating conditions comprise:

- Pigging operations
- Planned well service operations and other maintenance operations that could influence the stability of the oil/water separation processes
- Well clean-up operations, including coiled tubing
- Tests of new offshore chemicals that could influence the stability of the oil/water separation processes
- Change of equipment
- Start up or shut down
- Other situations, where DEPA, according to requirements in the discharge permits, has been notified by the operator of upcoming activities that could have a significant influence on the stability of the oil/water separation processes

The sampling frequency during both stable and unstable operating conditions is higher than the minimum required under OSPAR Recommendation 2001/1.

In addition the operators are required to report to DEPA if the concentration of dispersed oil has for 5 consecutive days been above 30 mg/l. The operator shall at the same time inform DEPA what action they have taken to ensure that the monthly concentration average will not exceed the 30 mg/l limit value.

It is also a requirement in the discharge permits that online analysers for process monitoring are installed at all produced water discharge points to provide a real time indication of produced water quality so that any deterioration in quality can be responded to as quickly as possible. During DEPA's inspections print outs from the records made by the online monitors are examined and if relevant compared to the actions taken by the operator to reduce the oil concentration if the discharged water. The operators have so far evaluated that measurements done by the online monitors are not accurate and stable enough to be used for the monthly reporting of dispersed oil in the produced water.

While operators are required to report analysis results in accordance with the OSPAR Reference method all operators continue to undertake onsite analysis using infrared techniques and the results are then converted to an OSPAR Reference Method result using correlation graphs, which are updated every three months.

Sampling and analysis of produced water and displacement water have to be done according to national or international standards and in accordance with the principles of good laboratory practise. The standards will be specific for each type of sample and each analysis. In regards to the quantification of the discharges of produced water and displacement water the discharge permits does not comprise specific requirements for the maximum uncertainty on the flow measurements.

The operators are required to report both monthly and annually according to requirements in the discharge permits. The quality of data submitted is the responsibility of each operator. They are required to carry out a systematic review of their own data. The operators have to include details related to this in their management systems. DEPA may at any time request to see the documentation.

As mentioned above the permits include requirements that the operators in the first half of each calendar year conduct and report to DEPA the results of an independent verification of both the oil in water sampling, analysing and reporting procedures and of the procedures related to the measurements of the flow of produced water discharged to the sea or re-injected including procedures for maintenance and

calibration of flow meters. If the verification shows significant deviations from the prescribed procedures the verification shall be repeated and reported to DEPA in the second half of the same year.

7.3. Reporting of chemical use and discharge

Operators on the DCS are required to record the use and discharge of all offshore chemicals in accordance with the terms and conditions of the permit. Operators are required to report the use and discharge to DEPA on a yearly basis. The reporting covers both the production and drilling activities carried out by the operator. There are no specific requirements in the discharge permits on how the operators should quantify the use and discharge of offshore chemicals, so it can in principle vary from operator to operator and in relation to the activities for which the chemicals are used and discharged. In some cases the reporting is based on quantities shipped from suppliers, which may only provide a rough estimate over a certain period but will average out over the year or longer periods. In other cases the operators record daily consumption from stock tanks on board the installation which provides a more accurate and consistent measurement. There is no measurement uncertainty requirement.

The operators' chemical management systems and methods of reporting are also reviewed during offshore inspections.

Appendix 1: OSPAR Measures associated with Offshore Oil and Gas industry

Discharges contaminated with oil

PARCOM Recommendation 86/1 of a 40 mg/l Emission Standard for Platforms[5];

OSPAR Reference Method of Analysis for the Determination of the Dispersed Oil Content in Produced Water (OSPAR Agreement number: 2005—15);

OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations (as amended);

OSPAR Recommendation 2012/5 for a risk-based approach to the Management of Produced Water Discharges from Offshore Installations

Use and discharge of drilling fluids and cuttings

OSPAR Decision 2000/3 on the Use of Organic-phase Drilling Fluids (OPF) and the Discharge of OPF-contaminated Cuttings;

Guidelines for the Consideration of the Best Environmental Option for the Management of OPF-Contaminated Cuttings Residue (OSPAR Agreement number: 2002—8);

Chemicals used and discharged offshore

OSPAR Decision 2000/2 on a Harmonised Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals (as amended);

OSPAR Recommendation 2010/4 on a Harmonised Pre-Screening Scheme for Offshore Chemicals;

OSPAR Recommendation 2010/3 on a Harmonised Offshore Chemical Notification Format (HOCNF) (as amended);

OSPAR Recommendation 2006/3 on Environmental Goals for the Discharge by the Offshore Industry of Chemicals that Are, or Which Contain Substances Identified as Candidates for Substitution;

OSPAR Recommendation 2005/2 on Environmental Goals for the Discharge by the Offshore Industry of Chemicals that Are, or Contain Added Substances, Listed in the OSPAR 2004 List of Chemicals for Priority Action.

[5] PARCOM Recommendation of a 40 mg/l Emission Standard for Platforms, 1986 was revoked for produced water only by OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations. However, this measure is still applicable in relation to ballast water, drainage water and displacement water from offshore installations.

Appendix 2 - Data

Table 1: Number of installations on the DCS with discharges to the sea, or emissions to the air 2013—2017

2013	2014	2015	2016	2017
14	20	20	20	21

Table 2: Oily aqueous discharges to the maritime area

Table 2a: Oil discharged in displacement and produced water (in tonnes), 2013—2017

2013 (GC-FID)	2014 (GC-FID)	2015 (GC-FID)	2016 (GC-FID)	2017 (GC-FID)
Dispersed	Dispersed	Dispersed	Dispersed	Dispersed
178	162	195	200	170

Table 2b: Dissolved oil discharged in displacement and produced water (in tonnes), 2013—2017

2013	2014	2015	2016	2017
BTEX	BTEX	BTEX	BTEX	BTEX
89	93	145	99	275

Table 2c: Total volume of produced water and displacement water discharged, and produced water injected (in m^3/year), 2013—2017

	2013	2014	2015	2016	2017
Produced water discharged	23.730.068	24.109.367	24.175.428	22.882.987	24.988.042
Produced water re-injected	12.446.062	10.645.576	13.497.375	11.257.941	11.995.583
Displacement water discharged	1.017.358	1.207.986	679.842	1.296.349	1.188.781
Total	37.193.488	35.962.929	38.352.645	35.437.277	38.172.406

* Produced water

** Displacement water

*** Injected produced and displacement water

Table 3: Installations which do not meet OSPAR performance standard for dispersed oil in aqueous discharges

Table 3b: Number of installations with discharges failing to meet the 30 mg oil/l performance standard, valid from 2007 onwards, and quantity of oil discharged by these installations (in tonnes)

	2013	2014	2015	2016	2017
Number of installations exceeding 30 mg/l	0	1	2	0	0
Quantity of dispersed oil discharged	0	0,006	0,3	0	0

Table 4: Use and discharges of organic-phase drilling fluids (OPF) and cuttings

Table 4a: Quantities of oil and other organic-phase fluids discharged via cuttings (in tonnes), 2013 - 2017

2013	2014	2015	2016	2017
Total OPF	Total OPF	Total OPF	Total OPF	Total OPF
0	0	0	0	0

Table 4b: Number of wells drilled with OPF, with discharge of contaminated cuttings to the maritime area, 2013 - 2017

2013		2014		2015		2016		2017	
OBF	non-OBF OPF	OBF	non-OBF OPF	OBF	Other OPF	OBF	Other OPF	OBF	Other OPF
4	0	5	0	5	0	7	4	0	0

Table 5: Spillage of oil and chemicals

Table 5a: Number of oil spills, 2013—2017 - Spills less than 1 tonne and spills above 1 tonne

2013		2014		2015		2016		2017	
≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t
47	1	74	3	54	0	43	0	35	1

Table 5b: Total quantity of oil spilled, in tonnes, 2013—2017

2013		2014		2015		2016		2017	
≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t
0	3	2	43	1,9	0	1	0	1,1	2,1

Table 5c: Number of chemical spills, 2013—2017 - Spills less or equal to 1 ton and spills above 1 ton

2013		2014		2015		2016		2017	
≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t
36	4	28	2	38	1	35	2	25	2

Table 5d: Total quantity of chemicals spilled, in tonnes, 2013—2017

2013		2014		2015		2016		2017	
≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t	≤ 1 t	> 1 t
2	26	2	9	1,3	116	1,1	42,2	1,1	2,6

Table 6: Emissions to air, 2013—2017

CO_2 (in millions of tonnes)

2013	2014	2015	2016	2017
1,78	1,77	1,80	1,77	1,63

NO_x (in thousands of tonnes)

2013	2014	2015	2016	2017
7,28	7,81	7,64	8,71	6,44

nmVOCs (in thousands of tonnes)

2013	2014	2015	2016	2017
1,77	2,17	2,25	2,43	1,62

CH_4 (in thousands of tonnes)

2013	2014	2015	2016	2017
4,01	3,72	3,85	3,86	3,41

SO_2 (in tonnes)

2013	2014	2015	2016	2017
116	145	99	160	80

Table 7: The use and discharge of offshore chemicals, 2013—2017

Table 7a: Quantity of offshore chemicals used in kg/year

	2013	2014	2015	2016	2017
PLONOR [B]	26.031.851	32.965.260,00	31.824.783	47.972.604	23.698.150
List of Chemicals for Priority Action	0	0	22	0	0
Inorganic LC_{50} or EC_{50} < 1 mg/l	0	0	9	29.425	49.104
Biodegradation < 20%	110.595	168.585,00	176.849	226.188	600
Substance meets two of three criteria	42.840	29.135	21.028	84.478	4.836
Inorganic, LC_{50} or EC_{50} > 1 mg/l	1.386.349	2.367.795	816.411	2.105.204	374.282
Ranking	12.578.135	15.602.959	14.630.468	18.138.083	12.258.371
Total	**40.149.770**	**51.133.734**	**47.469.570**	**68.555.982**	**36.385.343**

Table 7b: Quantity of offshore chemicals discharged in kg/year

	2013	2014	2015	2016	2017
PLONOR [B]	7.978.977	8.694.006,00	8.806.814	12.160.682	10.118.377
List of Chemicals for Priority Action	0	0	0	0	0
Inorganic LC_{50} or EC_{50} < 1 mg/l	0	0	0	18.247	30.306
Biodegradation < 20%	42	360	0,05	460	114
Substance meets two of three criteria	6.070	7.440	7.390	6.517	3.544
Inorganic, LC_{50} or EC_{50} > 1 mg/l	142.595	522.361,00	233.232	223.153	112.930
Ranking	5.148.251	4.786.125	4.556.915	4.664.838	5.605.816
Total	**13.275.935**	**14.010.292**	**13.604.351,05**	**17.073.897**	**15.871.087**

Table 7c: Chemicals spilled in kg per year

Pre-screening category	2013	2014	2015	2016	2017
PLONOR [B]	25.008	7.355	66.855	41.231	1.006
List of Chemicals for Priority Action	0	0	0	0	0
Inorganic LC_{50} or EC_{50} < 1 mg/l	0	0	0	0	122
Biodegradation < 20%	1.422	0	1.500	0	0
Substance meets two of three criteria	0	0	0	0	0
Inorganic, LC_{50} or EC_{50} > 1 mg/l	0	0	0	0	0
Ranking	1.463	177	37.280	184	0
Total	**27.893**	**7.532**	**105.635**	**41.415**	**1.128**

Table 8: Denmark total production in oil equivalents (tonnes)

2013	2014	2015	2016	2017
13.674.575	13.035.469	12.662.022	11.769.054	11.639.294

The Aspect
12 Finsbury Square
London
EC2A 1AS

t: +44 (0)20 7430 5200
f: +44 (0)20 7242 3737
e: secretariat@ospar.org
www.ospar.org

OSPAR's vision is of a clean, healthy and biologically diverse North-East Atlantic used sustainably

ISBN 978-1-911458-81-4
Publication Number: 741/2019