OSPAR
COMMISSION

Offshore Industry Thematic Assessment

OSPAR
QUALITY STATUS REPORT 2023

2022

OSPAR's Quality Status Report 2023

Offshore Industry Thematic Assessment

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l´Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d´Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. Les Parties contractantes sont l´Allemagne, la Belgique, le Danemark, l´Espagne, la Finlande, la France, l´Irlande, l´Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume- Uni de Grande Bretagne et d´Irlande du Nord, la Suède, la Suisse et l´Union européenne

Contributors

Lead authors: Reidunn Stokke and Saravanan Marappan

Supporting authors: Mikael Palme Malinovsky, Andrew Taylor, Bee Berx, Federico Cornacchia and Adrian Judd

Supported by: Intersessional Correspondence Group on OIC deliverables to the Quality Status Report (OIC-ICG-QSR), Offshore Industry Committee (OIC), on managing delivery of the Quality Status Report 2023 (ICG-QSR), Intersessional Correspondence Group on Ecosystem Assessment Outlook – Cumulative Effects Assessment (ICG-Eco-C), Intersessional Correspondence Group on Economic and Social analyses (ICG-ESA), Climate Change Expert Group (CCEG) and the OSPAR Secretariat.

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Executive Summary

The environmental pressures from offshore industry during exploration, production and decommissioning include the discharge of produced water, oil, chemicals, drilling muds and cuttings, the physical impact from the placement of installations and pipelines, noise from seismic surveys and drilling, light emitted from the installations, and atmospheric emissions.

These pressures are greatest in the Greater North Sea, followed by the Arctic Waters and Celtic Seas Regions. In the Bay of Biscay, Iberian Coast and Wider Atlantic Regions, there are fewer installations and the pressures are considered to be relatively low.

OSPAR has put in place a significant number of measures aimed at reducing the discharges from offshore industry within the OSPAR area and thus reducing their impacts on the marine environment.

Studies have been undertaken by Contracting Parties examining the potential impacts, including historical cuttings piles, produced water, drilling fluids and chemicals. There has been a measurable decrease in emissions and discharges since QSR 2010. Activities that were once widespread, such as the discharge of oil-based fluids, have ceased and the level of contamination has decreased over most of the OSPAR area. A lessening of existing impacts has been seen, for example a reduction in the amount of dispersed oil discharged in produced water and the phase out and reduction of discharges of hazardous offshore chemicals. A risk-based approach to the management of produced water discharges has also been introduced.

Contracting Parties have also fully implemented the ban on dumping or leaving in place disused offshore installations. Since 1998, approximately 170 installations have been decommissioned and 10 installations granted derogations from the ban.

Monitoring and reporting indicate that these OSPAR measures have significantly improved the quality of the OSPAR Maritime Area as a whole, particularly in the North Sea, where there are high levels of oil and gas activity.

OSPAR will continue its work in accordance with the relevant operational objectives set out in the North-East Atlantic Environment Strategy 2030 (NEAES 2030).

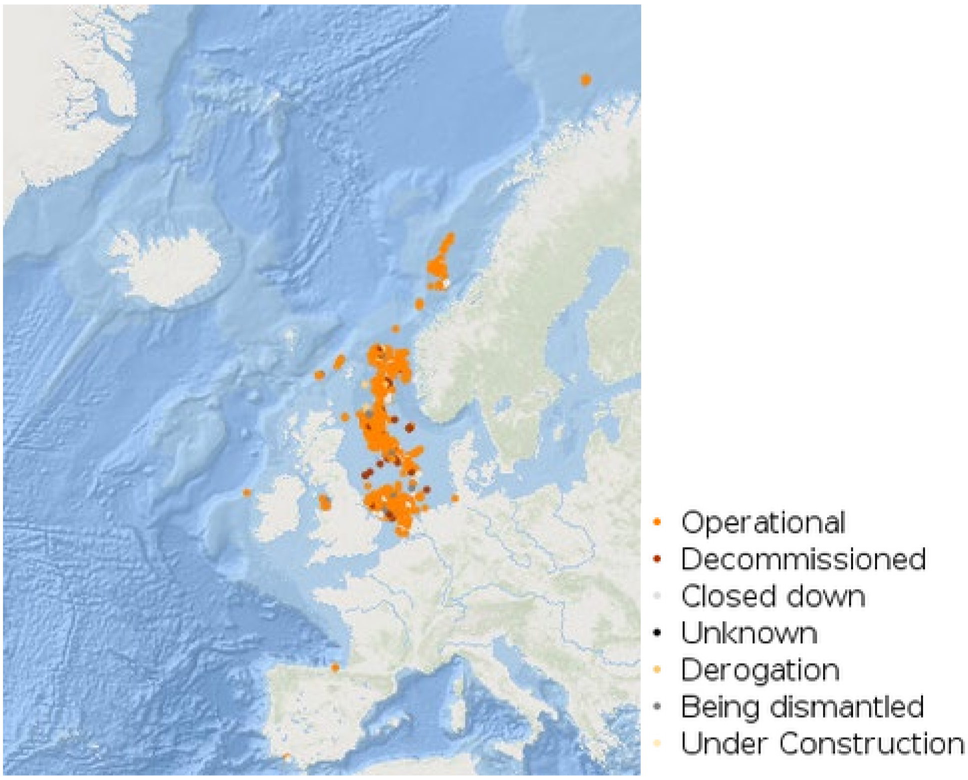


Figure 1: Details of the location and status of Offshore Installations within the OSPAR maritime area in 2019. Available at: https://odims.ospar.org/en/submissions/ospar_offshore_installations_2019_01/

Q1. Identify the problems? Are they the same in all OSPAR Regions?

Impacts across the OSPAR Regions

Offshore oil and gas activities have developed in the OSPAR area over the past 50 years. Environmental pressures can arise throughout the lifecycle of these activities, from exploration to production and decommissioning, through the discharge of produced water, oil, chemicals, drilling muds and cuttings, the physical impact of the placement and removal of installations and pipelines, noise from seismic surveys and drilling, light emitted from the installations, and atmospheric emissions.

These pressures are greatest in the Greater North Sea, followed by the Arctic Waters and Celtic Seas Regions. In the Bay of Biscay and Iberian Coast and Wider Atlantic Regions, there are fewer installations and the pressures are considered to be relatively low.

Produced water is the main source of oil discharge

Produced water is a by-product of oil and/or gas production operations and includes formation water, condensation water and re-produced injection water. The continuous discharges of produced water are an environmental concern, as they represent the largest source of crude oil contamination of the sea from offshore oil and gas operations. In addition to the natural pollutants in the oil, potentially hazardous production chemicals are also discharged.

Produced water is usually either discharged into the sea after treatment or injected back into the reservoir from where it originated. The main source of oil discharge from routine offshore oil and gas production operations is produced water.

Offshore chemicals can affect marine organisms

Offshore chemicals are used in a variety of applications during drilling, production, and decommissioning operations. The main discharges of chemicals arise from drilling activities and discharges of produced water. Some of these chemicals may be hazardous because they contain substances that are either persistent, toxic and/or bio-accumulative. The effects on marine organisms when such chemicals are discharged into the marine environment can be acute or long term, and can ultimately have effects on human health via the food web.

The drilling process involves the use of drilling fluids (or muds) and the discharge of drilling fluids along with drill cuttings, which may cause some smothering in the near vicinity of the well location. The impacts from such discharges are localised and transient but may be of concern in areas with sensitive benthic fauna, for example corals and sponges. Concerns have been raised about possible releases of oil and chemicals from the disturbance of historic cuttings piles during decommissioning activities or during bottom trawling after decommissioning.

Physical footprint

The physical presence of installations and pipelines will potentially lead to physical and biological changes on the seabed. Designated protected areas, particularly those containing habitats such as sandbanks and biogenic reefs, are likely to be more sensitive to these changes than the wider maritime area.

Noise can affect marine organisms

Anthropogenic noise emitted in the marine environment can potentially affect marine organisms in various ways. It can mask biologically relevant signals; it can lead to a variety of behavioural reactions; hearing organs can be affected, leading to hearing loss, and, at very high received levels, sound can injure or even kill marine life. The documented effects on marine life vary greatly, from very subtle behavioural changes, avoidance reaction and hearing loss to injury and death in extreme cases.

Light from installations may affect migrating birds

There are concerns about the impacts on migrating birds caused by flaring and lighting from offshore installations. A significant number of bird species migrate across the North Sea and may become attracted to offshore light sources, with fatal consequences for many individuals.

Q2. What has been done?

The OSPAR Commission has put in place a significant number of measures aimed at reducing emissions and discharges from the oil and gas industry within the OSPAR Maritime Area. The vast majority of these have been made since 2000 and aim to reduce the environmental impacts of the industry on the marine environment. Measures introduced by OSPAR have reduced oil in produced water discharges and the use and discharge of chemicals and drilling fluids. OSPAR has with a few exceptions, effectively prohibited the disposal of disused offshore installations at sea.

OSPAR measures to manage pressures from offshore oil and gas and carbon dioxide storage

- Decision 2000/3 on the Use of Organic-Phase Drilling Fluids (OPF) and the Discharge of OPF-Contaminated Cuttings;
- Recommendation 2012/5 for a Risk-based Approach to the Management of Produced Water Discharges from Offshore Installations, as amended by OSPAR Recommendation 2020/3;
- Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles;

- Recommendation 2001/1 for the Management of Produced Water from Offshore Installations, as amended by OSPAR Recommendation 2006/4 and Recommendation 2011/8;
- Decision 2000/2 on a Harmonised Mandatory Control System for the Use and Discharge of Offshore Chemicals, as amended by Decision 2005/1;
- 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, as amended by OSPAR Recommendation 2019/2;
- 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;
- Recommendation 2010/3 on a Harmonised Offshore Chemical Notification Format, as amended by OSPAR Recommendation 2014/17, OSPAR Recommendation 2019/3 and OSPAR Recommendation 2021/8;
- Recommendation 2017/1 on a Harmonised Pre-screening Scheme for Offshore Chemicals;
- Decision 98/3 on the Disposal of Disused Offshore Installations;
- Recommendation 2010/18 on the prevention of significant acute oil pollution from offshore drilling activities;
- Recommendation 2003/5 to Promote the Use and Implementation of Environmental Management Systems by the Offshore Industry, as amended by OSPAR Recommendation 2021/7;
- Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations;
- Decision 2007/1 to Prohibit the Storage of Carbon Dioxide Streams in the Water Column or on the Seabed.

Q3. Did it work?

Studies have been undertaken by OSPAR Contracting Parties looking at a wide range of potential pressures including those from historical cuttings piles, discharges of produced water, drilling fluids and chemicals. There has been a measurable decrease in emissions and discharges. Impacts that were once widespread, for example from the discharge of oil-based fluids, have now ceased and the level of contamination has decreased over most of the OSPAR area. Where potential impacts may still occur, these have been reduced, as in the case of the amount of dispersed oil discharged in produced water; the phase out of added chemicals identified for Priority Action (OSPAR's List of Chemicals for Priority Action (LCPA)) and the reduction in discharges of hazardous offshore chemicals.

The following summarises the progress made:

- **A 16% reduction since 2009 in dispersed oil discharged in produced water** has been achieved through the application of the standards set out in OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations, as amended.
- **A decrease in the number of installations exceeding 30 mg/l of dispersed oil in produced water discharged to sea** has been achieved through the application of the performance standard set out in OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations, as amended.
- **The phasing out of added chemicals identified for Priority Action (LCPAs**) was achieved through the application of 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.
- **The almost 50% reduction in the use and discharge of substances carrying substitution warnings** can be directly attributed to the implementation of 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, as amended.

- **The introduction of a risk-based approach to assess the environmental risk posed by produced water discharges including naturally occurring substances,** in accordance with OSPAR Recommendation 2012/5 for a risk-based approach to the Management of Produced Water Discharges from Offshore Installations, as amended To date, 54 % of installations have been assessed as having their discharges under adequate control, 39 % require further action to be taken, and the remainder are still under assessment.
- **Disused offshore installations are no longer dumped in the OSPAR Maritime Area,** in accordance with OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations. Since 2010, four derogations for footings of steel installations have been issued and further derogations for footings with one steel installation and three gravity based concrete installations were under consideration. A total of 170 installations have been decommissioned.

Q4. How does this field affect the overall quality status?

Monitoring and reporting indicate improvement

The exploration and development of oil and gas within the OSPAR Maritime Area have affected different parts of the environment of the North-East Atlantic. Studies show that the implementation of OSPAR measures has resulted in a measurable decrease in discharges and associated impacts. Impacts that were once widespread, for example from the discharge of oil-based fluids, have ceased, and the level of contamination has decreased over most of the OSPAR area. Where potential impacts still occur, they have been reduced, for example by over 20% in the amount of dispersed oil discharged in produced water; by the phase out of discharges of added offshore chemicals identified for Priority Action (LCPA); and by almost 50% in the discharge of chemical substances identified as candidates for substitution (although further reductions in discharges are considered possible).

Evidence from monitoring and reporting indicates that the overall effect of these OSPAR measures and their implementation by Contracting Parties has been to significantly improve the overall quality status of the OSPAR Maritime Area as a whole, particularly in areas of Region II where there are high levels of oil and gas activity.

The progress made in relation to the North-East Atlantic Environment Strategy 2010 – 2020 thematic objectives may be described as follows:

- *To achieve, by 2020, a reduction of oil in produced water discharged into the sea to a level which will adequately ensure that each of those discharges will present no harm to the marine environment.*

  There has been reduction in both the concentration of oil in produced water discharges and the volume of oil discharged. Work is ongoing to ensure that oil in produced water discharges does not present harm to the marine environment.

- *To have phased out, by 1 January 2017, the discharge of offshore chemicals that are, or which contain, substances identified as candidates for substitution, except for those chemicals where, despite considerable efforts, it can be demonstrated that this is not feasible due to technical or safety reasons (OSPAR Recommendation 2006/3).*

  While progress has been made in reducing the use and discharge of chemicals identified as candidates for substitution since the introduction of OSPAR Recommendation 2006/3, phase-out has not been achieved. Recognising that more needs to be done to reduce discharges of substitution chemicals a new deadline to phase out by 1 January 2026 has been agreed.

- *To continue monitoring the development of carbon capture and storage with the objective to ensure that CO_2 streams are retained permanently in geological formations and will not lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the Maritime Area (OSPAR Decision 2007/2).*

  There are only two full-scale projects on carbon dioxide storage in the OSPAR area. Due to this very limited number, an evaluation of the effectiveness of OSPAR Decision 2007/2 has not yet been undertaken.

Q5. What do we do next?

OSPAR will continue to take all possible steps to prevent and eliminate pollution and adopt the necessary measures to protect the OSPAR Maritime Area against the adverse effects of human activities.

Since QSR 2010 and thanks to the implementation of OSPAR measures by Contracting Parties and industry, the oil and gas industry has made measurable progress and improvements in reducing environmental impact. However, there are areas where it may be possible to further reduce the potential impacts, including the following:

- Linking estimated risk levels calculated through the risk-based approach to possible impacts in the receiving environment is a step that has not yet been addressed.
- While progress has been made in reducing the use and discharge of chemicals identified as candidates for substitution since the introduction of OSPAR Recommendation 2006/3, the challenge remains to phase out discharges of substitution chemicals.
- Continuous improvement remains a challenge, with hydrocarbon production at different stages in different regions and new developments continuing in Region I and II.
- Good practice guidelines for geophysical surveys and use of explosives need to be developed and is relevant to the OSPAR regional action plan to reduce noise pollution.
- On decommissioning, as older installations reach their end-of-life, it is anticipated that a number of installations will be decommissioned in the coming decade. While there has been progress in advancing certain technical capabilities, such as the increase in lift capabilities for removing topsides and steel jacket installations, no technology has been developed that would support a reduction in the categories eligible for derogation from OSPAR Decision 98/3.
- There are only two full-scale projects on carbon dioxide storage in the OSPAR area. Due to this very limited number, an evaluation of the effectiveness of OSPAR Decision 2007/2 has not yet been undertaken. While scientific knowledge of the environmental risks of carbon dioxide storage in geological formations is developing, the need for improving and refining the reporting to OSPAR on environmental monitoring of carbon dioxide storage projects has been identified.

Work will continue in accordance with the relevant operational objectives set out in NEAES 2030:

- **S2.O3** By 2027 OSPAR will ensure that measures to eliminate discharges, emissions and losses of hazardous substances are in place to achieve or maintain good environmental status for hazardous substances, including through working regularly with other organisations.
- **S2.O4:** By 2026 OSPAR will further develop the Harmonised Mandatory Control System for the use and discharge of offshore chemicals to improve coherence with other relevant international requirements such as the EU REACH[1] Regulation and the Biocidal Products Regulation.

[1] Regulation (EC) No 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

- **S4.O5:** By 2025 OSPAR will adopt programmes and measures to control and, where appropriate, phase out plastic from materials placed at sea for the purposes of marine infrastructure developments.
- **S4.O6:** By 2027 OSPAR will develop measures to control, and where possible, phase out discharges of plastic substances, including microplastics, contained in chemicals from offshore sources.
- **S7.O1:** By 2028 OSPAR will further develop methods for the analysis of cumulative effects in the marine ecosystems of the North-East Atlantic, taking into account relevant spatial and temporal information on human activities, pressures, sensitive receptors and habitats, and use the results to inform the establishment of measures and actions to prevent, reduce or otherwise manage impacts.
- **S8.O1:** By 2025 OSPAR will agree a regional action plan setting out a series of national and collective actions and, as appropriate, OSPAR measures to reduce noise pollution.
- **S9.O2:** By 2023 OSPAR will review and, if appropriate, amend the categories of disused offshore installations where derogations may be considered under OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations, aiming to reduce the scope of possible derogations. The review will be based, inter alia, on the advancement of decommissioning technologies and on the best available scientific knowledge.
- **S9.O3:** By 2023 OSPAR will agree on an approach and on actions to promote and advance decommissioning technologies under the framework of Decision 98/3 with the aim of reducing the scope of possible derogations.
- **S10.O3:** In 2023, and every 6 years thereafter, OSPAR will assess the current and projected impacts of climate change and ocean acidification on the OSPAR maritime area and its uses, to inform the development of national and international actions.
- **S12.03:** By 2024 OSPAR will review the results of monitoring that is undertaken in relation to carbon dioxide storage to assess whether the monitoring techniques deployed are adequate to demonstrate that carbon dioxide streams are retained permanently in the storage complex. By 2026 OSPAR will evaluate the effectiveness of OSPAR measures to ensure that carbon dioxide streams are retained permanently in the storage complex and will not lead to any significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area.

D - Drivers

Drivers for the offshore industry

The drivers considered most relevant for the offshore industry are:

Society's need for energy: Society and the economy are dependent on reliable energy supplies. With increasing human population and existing / emerging technologies which are more reliant on energy, demand for energy continues to increase. While policies are shifting towards low carbon economies, during the transition there is an ongoing need for oil and gas to be part of the energy mix in order for OSPAR Contracting Parties to meet society's demands for energy. There is also an ongoing need to continue to assess and apply measures to reduce the pressures on the marine environment emanating from the offshore oil and gas sector.

Society's need for stable economies: Revenue from oil and gas exploration, production, processing and associated products is an important (and significant) component of OSPAR Contracting Parties' economies.

Society's need to mitigate the effects of Climate Change: Fossil fuel extraction and consumption are forecast to reduce with time in order to meet the international commitments to reduce and mitigate the effects of climate change. In addition, the reduction of CO_2 emissions through the use of carbon capture and storage

(CCS), as well as the transition to electrification, are expected to reduce the pressures associated with oil and gas, although CCS will introduce its own pressures into the marine environment.

The following drivers may also be relevant:

Society's need for industrial processes: Many industrial processes and the products they supply use materials from the oil and gas sector.

Society's need for trade and movement of goods: Domestic and international trade is reliant on fuels to power the vehicles needed to import and export goods and services critical to the economies of most OSPAR Contracting Parties.

Society's need for materials: A wide range of products derive from petrochemicals. The extraction, transportation and processing of many materials are reliant on fuels derived from the oil and gas sector.

A – Activities

Extraction of oil and gas and carbon dioxide storage

Table A.1: Trends in oil and gas activities; exploration, production and decommissioning

	Arctic Waters (Region I)	Greater North Sea (Region II)	Celtic Seas (Region III)	Bay of Biscay and Iberian Coast (Region IV)	Wider Atlantic (Region V)
Relative intensity	M	H	M	L	L
Trend since QSR 2010	↔	↔	↔	↔	↔
Expected trend to 2030	↔	↔	↔	↔	↔

Extraction of oil and gas, including infrastructure [Extraction of non-living resources]

Region I

Iceland, Denmark, and Norway have activities in Region I.

Two areas on the Icelandic continental shelf are thought to have potential for commercial accumulations of oil and gas. However, there are currently no active licences or oil and gas activity in Icelandic waters.

So far five licences have been granted in the waters north-east of Greenland. Exploration drilling has been performed in waters outside the OSPAR area. There are presently no plans for activity on the Faroe Islands.

In the Norwegian part of Region I, there are activities both in the Norwegian Sea and the Barents Sea. New gas infrastructure has been established in the northern part of the Norwegian Sea: the Aasta Hansteen field, which started production in 2018, and the gas pipeline Polarled. There are currently two fields in production in the Barents Sea, namely Snøhvit and Goliat, and a third, Johan Castberg, is under development, and production will start in 2023. In 2021 an impact assessment programme for the development of the Wisting discovery in the Hoop area of the Barents Sea, was submitted. The increase in activity in the Barents sea is, however, expected to be counteracted by decreasing activity, and ultimately the decommissioning of mature fields, in the Norwegian sea. The trend towards 2030 is therefore expected to be stable. According to reported data, activity and discharges in Region I can also be regarded as having been stable since QSR 2010.

Region II

Region II has more oil and gas development than any other OSPAR Region, with exploration and production occurring in Denmark, Germany, the Netherlands, Norway, and the United Kingdom. Exploration and production have been carried out in this Region since the early 1960’s. The major oil developments have been in the northern part of the North Sea in the United Kingdom, Norwegian, and Danish sectors. Gas deposits are exploited mainly in the southern regions of the United Kingdom, Dutch, and Danish sectors, as well as in Norwegian waters. There are a limited number of gas and oil production platforms in the Wadden Sea (Germany). Seismic surveys covering large areas of the United Kingdom waters in Region II were undertaken in 2015 and 2016. However, significant change in activity trends is not expected. As Region II has the longest history of oil and gas development and the most mature oil and gas fields, many of the activities that caused impacts during the earlier years of development up until the 1990~~’~~s have ceased and the main concerns now relate to impacts from historical cuttings piles and the discharge of produced water.

Region III

Exploration drilling in Region III has been undertaken in the Celtic Seas since 1969, with oil production starting in 1985. The region where most oil and gas development occurs is dominated by relatively shallow bays in three separated sea areas (Celtic, Irish and Malin Seas). Most of the production facilities and pipelines are situated in the Irish Sea, in particular around Liverpool and Morecambe Bay off the English coast. Production of gas from the Kinsale area gas fields, located off Cork and the only production facilities in the Celtic Seas, ceased in 2020 and the facilities are currently being decommissioned.

Region IV

Region IV has potential for oil exploitation in the sedimentary basins in the inner south-eastern part of the Bay of Biscay. The coastal plains of Aquitaine (France) and the Northern coast of Spain have historically been exploited, and Spain operates a few installations on the shelf. There is also gas production in the Gulf of Cadiz, with a pipeline to the shore.

Region V

Exploration and development activities within Region V, the Wider Atlantic, have been limited: only one installation is reported to contribute to emissions and discharges.

Table A.2: Distribution of oil and gas installations in the OSPAR area

OSPAR Region	Installations with discharges / emissions	All installations[1]
Arctic Waters (Region I)	18	129
Greater North Sea (Region II)	627	1 371
Celtic Seas (Region III)	28	33
Bay of Biscay and Iberian Coast (Region IV)	2	5
Wider Atlantic (Region V)	1	1
Total	676	1 539[2]

[1] Including subsea infrastructure and derogated installations

[2] Discrepancy with installation co-ordinates is currently being investigated

Society’s needs for energy and stable economies are both drivers for the extraction of oil and gas.

Environmental pressures can occur throughout the lifecycle of oil and gas activities and can arise from the discharge of produced water, oil, chemicals, drilling muds and cuttings, the physical impact from the placement and removal of installations and pipelines, noise from seismic surveys and drilling, light emitted from the installations, and atmospheric emissions.

Exploration includes seismic surveys and the drilling of exploratory and appraisal wells. Production includes the drilling of production and injection wells and the construction, placement, and operation of infrastructure to produce oil and gas. Decommissioning, the final phase of an oil and gas field when the production cycle comes to an end, involves activities such as the plugging of wells and the removal of infrastructure.

The production of hydrocarbons decreased by 28% over the ten-year period from 2009 to 2019, though production increased from 2014 to 2016 by approximately 17% before levelling off. The number of installations with emissions and discharges reported in the OSPAR Maritime Area was the same in 2019 as in 2009 (676). The same period, however, saw a 14% increase in the number of reported installations up to a maximum of 766 installations in 2015, followed by a 12% decline to 676 installations by 2019. This decline was largely due to increasing cessation of production and decommissioning following the drop in the oil price in 2014. Since OSPAR Decision 98/3 on the disposal of disused offshore installations was adopted, approximately 170 installations have been decommissioned, of which 10 were granted derogations.

Drilling activity, despite the downturn during 2013 to 2015, increased over the period from 382 wells drilled in 2011 to 443 wells drilled in 2019, with a peak of 490 wells drilled in 2017. Most of these wells were development wells rather than exploration and appraisal wells. There has been a decline in drilling activity in Ireland, the Netherlands, and Denmark, while activity in Norway and the United Kingdom has remained relatively stable over the period with some annual variation.

The declining trend in production is expected to continue. As older installations reach their end-of-life, it is anticipated that the decommissioning activity will increase in the coming decade.

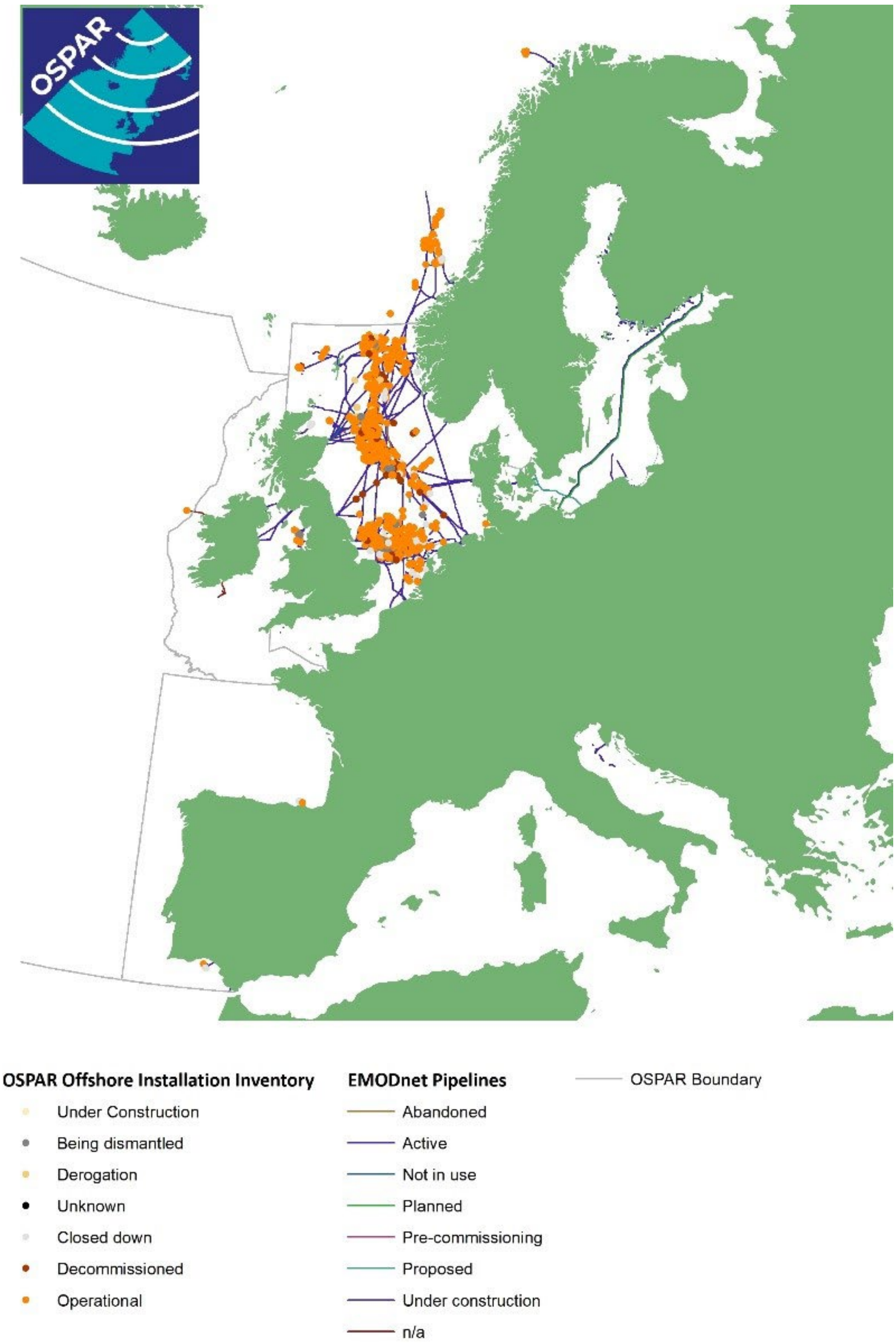


Figure A.1. Offshore oil and gas installations and pipelines in the OSPAR area

Reducing greenhouse gas emissions (decarbonisation) of oil and gas production is increasingly gaining focus, and the electrification of oil and gas installations from an onshore grid or from renewable sources is likely to gain traction.

Carbon capture and storage in sub-seabed geological structures (carbon dioxide storage)

Society's need to mitigate the effects of climate change is the main driver for carbon capture and storage.

Carbon dioxide capture and geological storage is a bridging technology that will contribute to mitigating climate change. It consists of the capture of carbon dioxide (CO_2) from industrial installations, its transport to a storage site and its injection into a suitable underground geological formation for the purposes of permanent storage.

Storage of carbon dioxide in geological formations including depleted oil and gas reservoirs and saline aquifers is an emerging offshore activity. There are two large-scale carbon dioxide storage projects currently operating in the OSPAR Maritime Area (*Sleipner* and *Snøhvit* in Norway). A number of new project proposals are at various stages of development including the *Greensand* project in Denmark, the *Porthos* and *Aramis* project in the Netherlands, the *Longship* project in Norway, and the *Acorn*, *Northern Endurance* and *HyNet North West* projects in the United Kingdom.

According to NEAES S12.03, OSPAR will by 2024 review the results of the monitoring undertaken in relation to carbon dioxide storage in order to assess whether the monitoring techniques deployed are adequate to demonstrate that carbon dioxide streams are retained permanently in the storage complex. By 2026, OSPAR will evaluate the effectiveness of OSPAR measures to ensure that carbon dioxide streams are retained permanently in the storage complex and will not lead to any significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area.

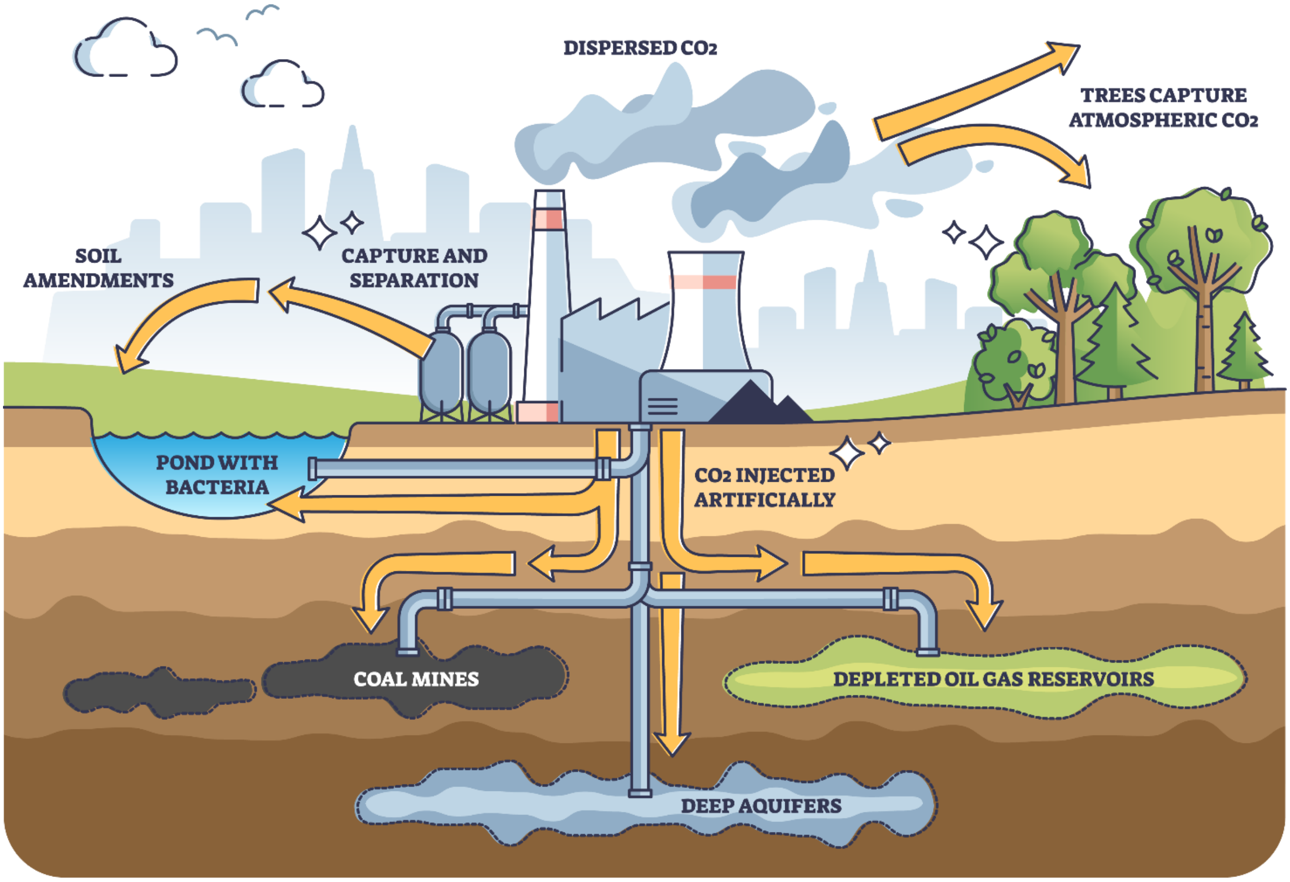


Figure A.2: Schematic to describe carbon capture and storage. © Shutterstock

P – Pressures

Pressures from the oil and gas industry and carbon dioxide storage

Table P.1: Trends in pressures from oil and gas activities

Pressures	Region I	Region II	Region III	Region IV	Region V
Relative intensity	M	H	M	L	L
Trend since QSR 2010	↔	↔	↔	↔	↔
Confidence[1]	Very high	Very high	Very high	Medium	Very high
Expected trend to 2030	↔	↔	↔	↔	↔

The pressure intensity from offshore oil and gas activities is greatest in the North Sea, followed by Arctic Waters and the Celtic Seas. In the remaining regions — Bay of Biscay, Iberian Coast and the Wider Atlantic— the number of installations is low and the pressure is considered to be relatively low. These trends are described in the table. Pressure intensity has been stable for all Regions since 2010 and is expected to remain stable towards 2030.

There has been a measurable decrease in emissions and discharges since QSR 2010.This conclusion is based on discharge data reported by Contracting Parties and assessments carried out by the Expert Assessment Panel and published in OSPAR's Assessment of the OSPAR Report on Discharges, Spills and Emissions from Offshore Installations, 2009 – 2019. This assessment method used basic linear regression, best professional judgement, and observation. The data is supported by environmental monitoring findings, and the confidence assessment expressed in **Table P.1** is based on data for these pressures, as this has been the main work area for the Offshore Industry Committee since 2010. The confidence level for this part of the data can be regarded as very high (high agreement, robust evidence), except for Region IV where reported data on discharges were sparse, and trends could not be determined.

For other pressures, such as physical pressure, noise and light, the confidence level can be regarded as medium to low. However limited evidence is available, and the confidence assessment is therefore uncertain.

Oil and gas industry

Oil and gas exploration and production within the OSPAR Maritime Area have affected the marine environment of the North-East Atlantic. The environmental pressures include discharges of produced water, chemicals, drilling fluids and cuttings, atmospheric emissions, noise, light and the physical impacts from the placement and decommissioning of pipelines and installations.

OSPAR Contracting Parties have conducted studies of historical cuttings piles, discharges of produced water, drilling fluids and chemicals. The results show that the implementation of OSPAR measures has resulted in a measurable decrease in pressures and associated impacts. Where potential impacts may still occur, they have been reduced.

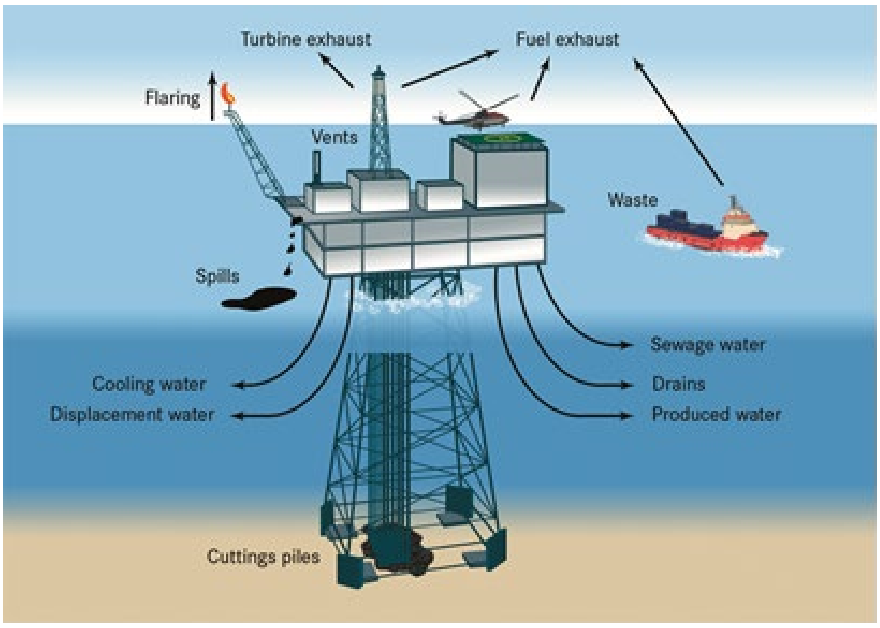


Figure P.1: Pressures on the environment from the oil and gas industry

- **Input of other substances (e.g., synthetic substances, non-synthetic substances, radionuclides), diffuse sources, point sources, atmospheric deposition, and acute events**

The different phases of the oil and gas industry will result in pressures stemming from the discharge of produced water, chemicals and drilling muds, accidental spills of oil and chemicals, and atmospheric emissions:

- **Discharge of produced water**

The amount of dispersed oil discharged in 2019 was 16% below that discharged in 2009. While there was no year-on-year decrease, the total quantity of dispersed[1] oil (aliphatic oil) discharged to the sea from produced water and displacement water decreased from 4 890 tonnes in 2009 to 4 096 tonnes in 2019. There was a notable increase in dispersed oil discharged in 2015 as a result of an increase in the amount of produced water discharged and in average dispersed oil concentrations.

Produced water and displacement water are the main contributors to the oil discharges from offshore oil and gas activities, representing 95-99% of the total amount of oil discharged to the sea during the 2009 to 2019 period. The exception was in 2011-2012, when a single large spill event accounted for 11-12% of the total oil to sea.

It should be noted that dispersed oil in displacement water contributes less than 1% to this total. The annual average dispersed oil content of produced water ranged from 12,4 mg/l to 14,1 mg/l over the period, well below the current performance standard of 30 mg/l for dispersed oil in produced water discharged into the sea.

Over the period 2009 to 2019, the total number of installations exceeding the performance standard decreased from 31 to 17. The amount of oil discharged from six of these installations was less than 2 tonnes annually. In total, the discharge of dispersed oil in excess of the performance standard was less than 2% of the total discharge of dispersed oil in the OSPAR area.

[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.

In 2013, Contracting Parties provided OSPAR's Offshore Industry Committee (OIC) with implementation plans under OSPAR Recommendation 2012/5 for a risk-based approach to the management of produced water discharges from offshore installations, and the majority commenced assessments in 2014 with the Recommendation due to be fully implemented by 2018. In 2019, of the 231 installations still included within the risk-based approach process, 216 had been assessed, with 125 installations (54%) determined as having their discharge adequately controlled and 91 installations (39%) as requiring further action to be taken, while the remainder were still awaiting the outcome of an assessment **(Figure P.2**).

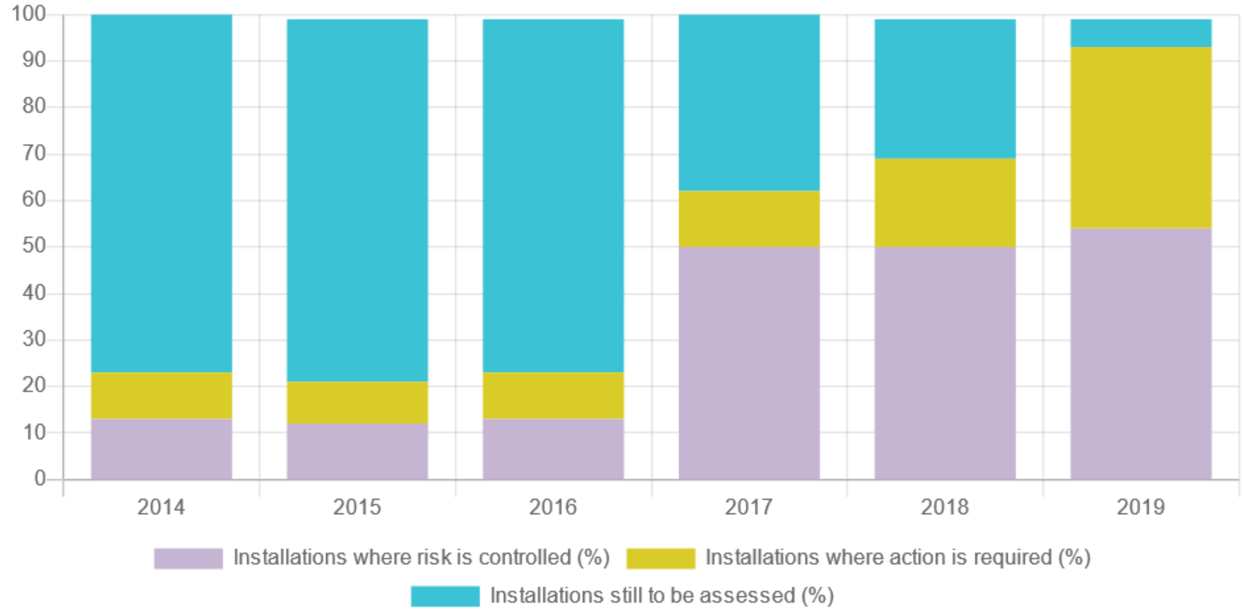


Figure P.2: RBA progress

Produced water discharges are the main source of radionuclides from oil and gas operations. Radionuclide discharges from oil and gas operations are covered in the Radioactive Substances Thematic Assessment.

- **Use and discharge of chemicals**

The total quantity of chemicals used offshore decreased from 838 111 tonnes in 2009 to 733 598 tonnes in 2019, of which 69% (wt.) were on the PLONOR list (OSPAR List of substances/preparations used and discharged offshore which are considered to Pose Little or No Risk to the environment) and less than 1% (wt.) contained substances which are candidates for substitution.

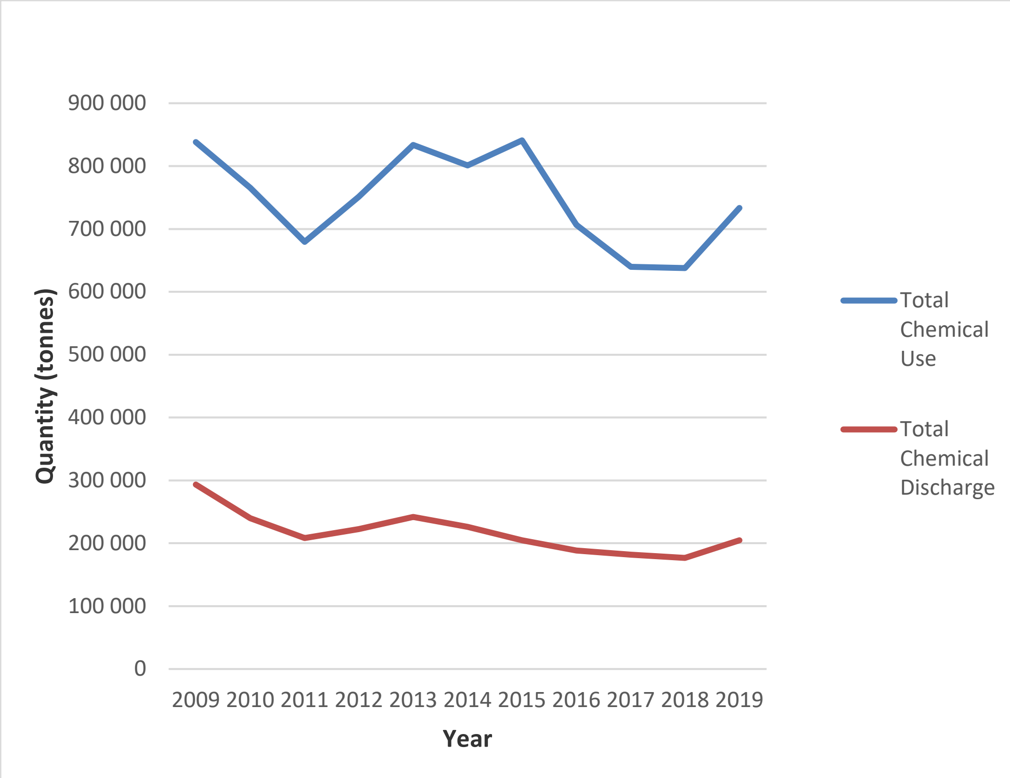


Figure P.3: Use and discharge of chemicals

The total quantity of chemicals discharged into the sea decreased from a peak of 293 402 tonnes in 2009 to 204 570 tonnes in 2019, of which 84% were on the PLONOR list and less than 0,5% (wt.) contained substances which are candidates for substitution.

The use of ranking[1] chemicals increased by 7% and their discharge decreased by 3% between 2009 and 2019. The use and discharge of PLONOR chemicals decreased by 18% and 34% respectively over the same period. It is not entirely clear if this was mainly due to an overall reduction in use and discharge and/or a change in categorisation of chemicals resulting in removal from the PLONOR list.

The use of added chemicals identified for priority action (LCPA) continued to decrease over the 2009 to 2019 period, from 3 929 kg to 111 kg .

The discharge of chemicals on the LCPA-list was phased out by 2014, and other than a 3 kg accidental permitting of an LCPA discharge in 2016 in the United Kingdom and a 0,5 kg unpermitted discharge in Denmark in 2019 there were no others.

[1] Ranking chemicals being the combination of inorganic chemicals with LC50 or EC50 greater than 1 mg/l and ranking chemicals, which includes substances ranked according to OSPAR Recommendation 2000/2 and don’t fall into another category.

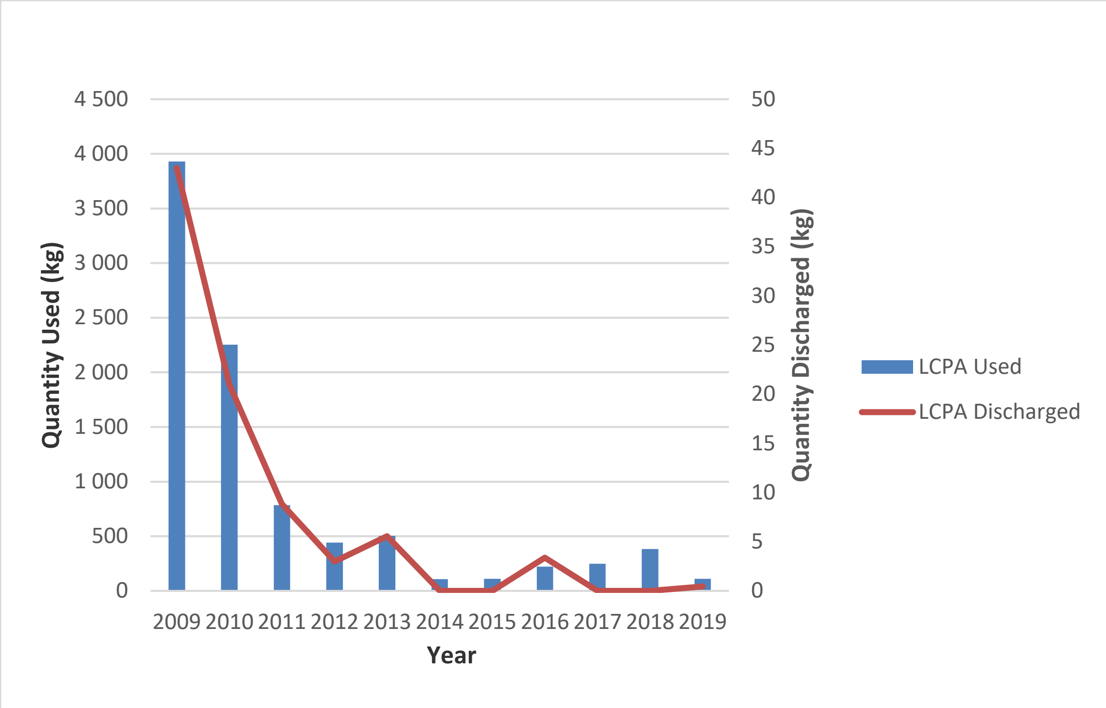


Figure P.4: Use and discharge of LCPA chemicals

The discharge of chemicals containing substances that are substitution chemicals fell from about 1 755 tonnes in 2013 to 1 012 tonnes in 2019, a 42% decrease.

The use of substitution chemicals with a biodegradation of < 20% or that meet 2 of the 3 PBT criteria decreased from 11 959 tonnes in 2009 to 7 739 tonnes in 2018, a 36% reduction. Similarly, discharge of these substitution chemicals decreased from 1 753 tonnes to 1 162 tonnes, a 35% reduction.

While progress has been made in reducing the use and discharge of chemicals identified as candidates for substitution since the introduction of OSPAR Recommendation 2006/3, more needs to be done to reduce discharges of substitution chemicals.

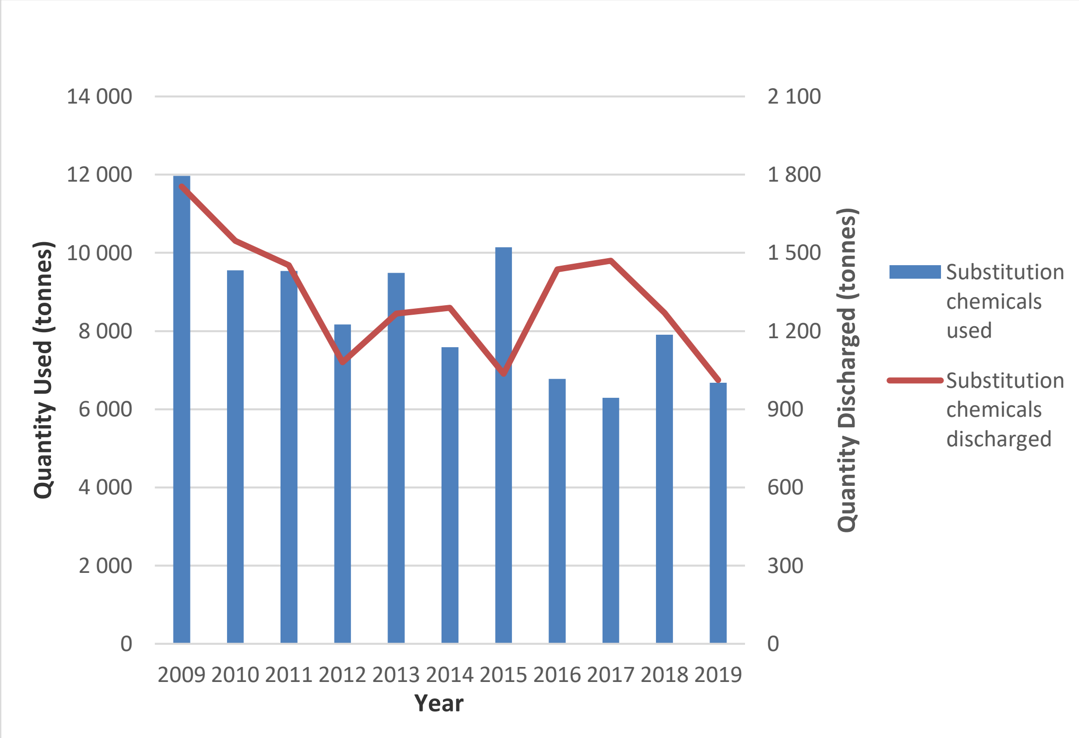


Figure P.5: Use and discharge of substitution chemicals

- **Discharge of drilling fluids**

The discharge of organic-phase fluids ceased in 1996 and no organic-phase fluid discharges have been reported since 2004 in the OSPAR area. The objective of Decision 2000/3 on the Use of Organic-Phase Drilling Fluids and the Discharge of Organic-Phase Fluids Contaminated Cuttings continues to be fulfilled.

In 2019, a total of 11 wells were drilled with organic-phase fluid with cuttings discharged into the sea after treatment to < 1% oil on cuttings. This is the same number as in 2009, and the annual numbers over the period ranged from 7 to 20 wells. Other organic-phase drilling fluids were used in one well in the United Kingdom in 2019 and all the cuttings were injected or transported to shore.

The availability of thermal desorption treatment technologies, which enable the 1% concentration limit to be achieved, has brought an increase in their use offshore, particularly in the United Kingdom. The use of these technologies led to an increase in the discharge of thermally treated organic-phase drilling contaminated cuttings from 0,3 tonnes in 2009 up to a maximum of 23 tonnes in 2016. However, all discharges were significantly lower than the 1% concentration performance standard (see **Figure P.6**). Less than 0,01 % of all the organic-phase drilling fluids used is discharged by using this technology.

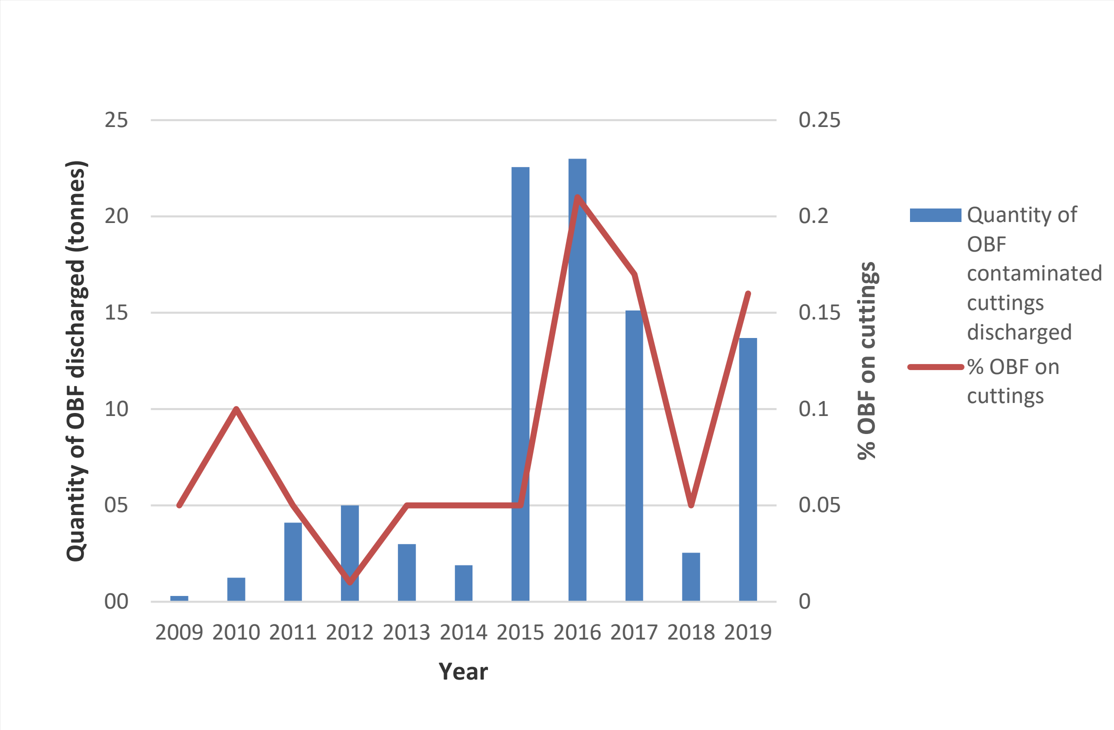


Figure P.6: Quantity of treated organic-phase drilling fluids contaminated cuttings discharged and concentration

- **Accidental spills**

Accidents or incidents occurring during the transportation of oil and gas by pipeline or tanker, as well as accidental spills from installations have the potential to cause impacts outside the area of production.

Accidental spills of oil

Over the period 2009 to 2019, the number of accidental spillages of oil to sea varied widely, with 2014 having the highest number of spills (572) and 2019 the lowest (338). While there has been annual variation, it is possible to identify a downward trend in the number of oil spills being reported since 2014.

The total quantity spilled each year is variable, with a high of 541 tonnes in 2012 when a single large spill in the United Kingdom contributed approximately 400 tonnes to the total, and a low of 44 tonnes in 2016 (see **Figure P.7**). In 2019, oil spills contributed less than 2% (wt) (106 tonnes) of the total amount of oil released to the sea from offshore oil and gas installations, the remaining 98% (4 096 tonnes) being dispersed oil discharged with produced water.

There is no discernible trend in the quantity of oil being spilled annually. Spills over 1 tonne account for just 2–4 % of the number of spills but account for 68–96 % of all the oil spilled on an annual basis. Consequently, the quantity spilled annually is very much the result of a small number of larger spills.

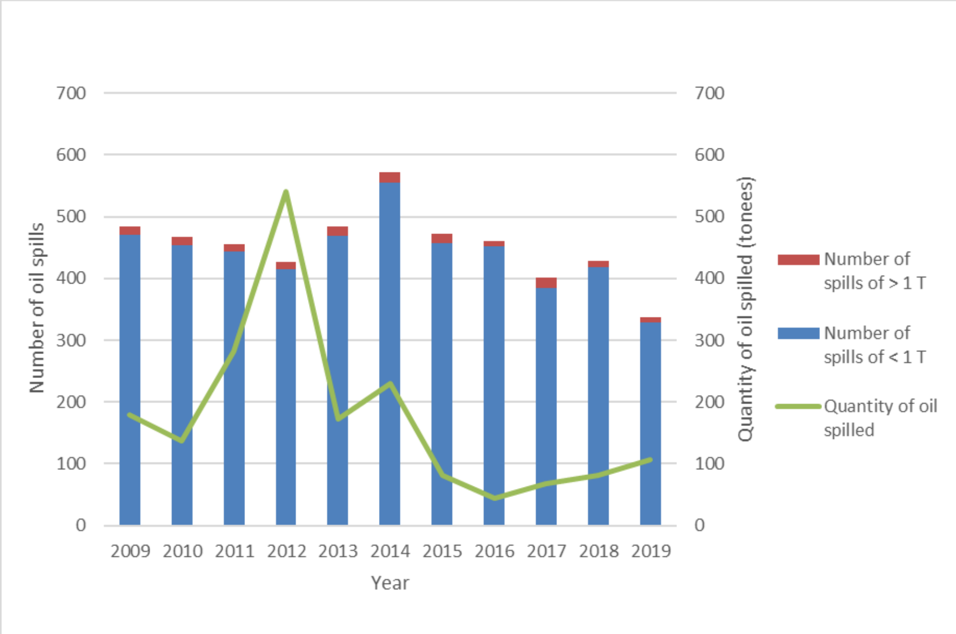


Figure P.7: Accidental oil spills

Accidental spills of chemicals

Over the period 2009 to 2019, the number of accidental spillages of chemicals to sea also varied widely, with 2014 having the highest number of spills (488) and 2019 the lowest (346). While there was annual variation, it is a possible to identify a downward trend in the number of chemical spills being reported since 2014. The number of larger spills (> 1 tonne) also trended downwards over the period, from 99 in 2009 to 55 in 2019.

The total quantity spilled each year was extremely variable, with a high of 14 464 tonnes in 2009 and a low of 728 tonnes in 2011 (see **Figure P.8**) and there was no discernible trend in the quantity of chemicals being spilled annually. Of the chemicals spilled in each year the vast majority – 97-99%) were either on the PLONOR list or were ranking chemicals.

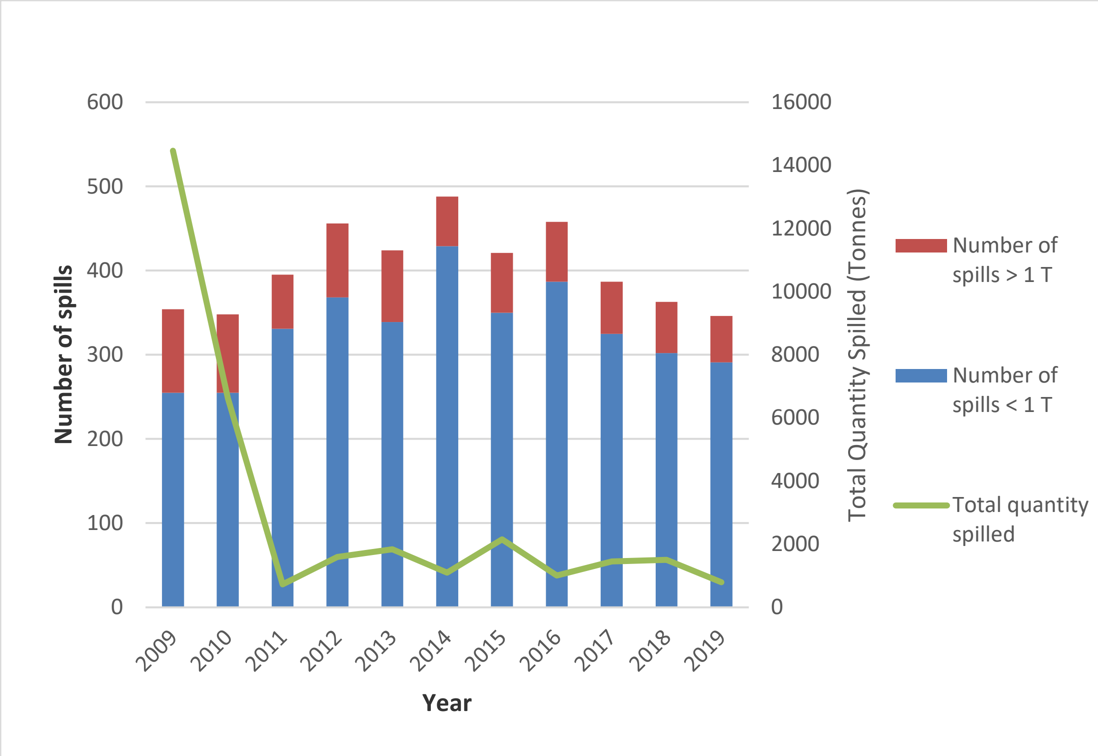


Figure P.8: Accidental chemical spills

- **Atmospheric emissions**

  Although atmospheric emissions are not covered by OSPAR measures, overall reductions have been reported in all atmospheric emissions across the OSPAR area over the last 10 years, most significantly in methane and SO_2 emissions. Over the 2009 to 2019 period:
  - CO_2 emissions decreased by 7,5%;
  - NO_X emissions decreased by 9,2%;
  - Methane emissions decreased by 35%;
  - NMVOC emissions decreased by 7,2%; and
  - SO_2 emissions decreased by 33%.

  As national and EU legislation is introduced to address local, regional, and international Net Zero commitments it is expected that emissions from offshore installations will continue to fall.

  This is further discussed under the climate change section.

- **Input of anthropogenic sound (impulsive, continuous)**

There are a number of distinct phases in oil and gas operations which can introduce pressures in the form of underwater noise, ranging from initial seismic exploration to drilling, production and then decommissioning. The most significant underwater noise associated with each phase is dependent upon the nature and scale of the specific activities. Geophysical surveys associated with the exploration and management of hydrocarbon reserves are a source of anthropogenic noise. Drilling for hydrocarbons requires the use of mobile drilling units or drilling equipment installed on fixed platforms, and the position-keeping propulsion mechanisms of some mobile drilling units are also a notable source of noise. Infrastructure installation activities involving underwater hammer piling, and the occasional use of explosives for well abandonment or the decommissioning of facilities, are also sources of underwater noise.

Anthropogenic noise emitted to the marine environment can potentially affect marine organisms in various ways. Impulsive sound sources have been observed to cause temporary displacement of small cetaceans (e.g., harbour porpoises), increased physiological stress in some fish species (e.g., European seabass) and developmental abnormalities in invertebrate larvae. In some cases, they may also be capable of causing more severe effects such as permanent auditory damage or blast injuries. While the effects on individual animals have been shown for a number of species, there is uncertainty as to whether and how the effects of sound on individuals are translated to the population or on ecosystem scale (2021 Indicator Assessment – Distribution of Reported Impulsive Sounds in the Sea).

Reported impulsive noise activity increased overall during the assessment period (2015-2019), with most reported activity occurring in the Greater North Sea Region. Seismic airgun surveys were the dominant sound source (Underwater Noise Thematic Assessment). Activity can change markedly between years. While it is notable that large-scale seismic surveys were carried out in United Kingdom waters during 2015 and 2016, significant change in activity trends is not expected.

- **Input of other forms of energy (including electromagnetic fields, light and heat)**

Flaring and lighting from offshore installations contribute to the pressures on migratory birds. A significant number of birds of different species migrate across OSPAR Region II (Greater North Sea) at least twice a year or use the Greater North Sea as a feeding and resting area. This migratory behaviour is an essential part of the birds' natural life cycle. Some species crossing or using the area may become attracted to offshore light sources, especially in deteriorating weather conditions which restrict visibility (e.g., low clouds, mist, drizzle). This attraction can be fatal and may involve large numbers of individuals of many species of birds. OSPAR Region II contains a substantial number of illuminated offshore installations where such attraction can potentially result in mortality. The OSPAR Workshop on research into possible effects of offshore platform lighting on specific bird populations (January 2012) noted that there is evidence that conventional lighting of some offshore installations has an impact on a large number of birds. The evidence is, however, not sufficient to conclude whether or not there is a significant effect at the population level. (See: Marine Birds Thematic Assessment)

- **Input of litter (solid waste matter, including micro-sized litter)**

A limited number of offshore chemicals contain plastic or microplastic substances which are used and discharged during other offshore operations.

Man-made infrastructures such as pipelines, cables and structures placed on the seabed are normally protected for a number of reasons, including protection from trawl boards, scouring and pipeline / cable crossings, as well as to provide foundation support, prevent buoyancy and provide stability.

The protection materials include concrete mattresses and sand or grout bags. Sand or grout bags are typically contained in polypropylene sacks. Concrete mattresses are often held together by polypropylene ropes. The life span of these protection materials is such that the plastic substances they contain deteriorate and eventually disintegrate over the extended periods for which they are deployed on the seabed, thus contributing to marine plastic litter and the presence of microplastics. (See: Marine Litter Thematic Assessment)

- **Physical disturbance to the seabed (temporary or reversible)** and
- **Physical loss (due to permanent change of seabed substrate or morphology and the extraction of seabed substrate)**

- **Physical impact**

Physical disturbance to the seabed and physical loss of seabed will result from the placement of pipelines, installations, cables, and associated structures. Owing to the number and length of pipelines placed on or under the seabed, their overall physical impact is greater than that from other installations.

Pipelines are either placed on the seabed or buried partly or completely in the sediment. The actual placement of the pipelines causes impacts, particularly in areas where they are to be trenched and buried. Pipelines are buried to ensure that they are not buoyant and remain in place; this also reduces the potential hazards for fishing activities.

The footprint of the pipeline, or the affected zone around it, depends on length, diameter, the depth of burial or build-up of gravel, the presence of hard substrate, and other factors. Pipeline burial causes the largest impact during the installation phase because of the considerable disturbance to the seabed and to the mobilisation of sediment. The area of impact during pipeline burial is considered to be within 10–20 m of the line, but once buried, pipelines usually have insignificant impacts.

Due to differences in bottom topography, geology, water mass movement and other environmental factors such as the sensitivity of benthic species and habitats (particularly cold-water corals and sponges), the pressures resulting from the introduction of these structures will vary according to the natural conditions in the different OSPAR Regions.

The decommissioning of pipelines and removal of installations and associated infrastructure can cause sediment disturbance and subsequent localised impacts. Similarly, if there is a cuttings pile at the base of the platform this may be disturbed and the contaminated cuttings re-suspended. On occasions it may not be possible to remove the lower parts of a platform, such as concrete substructures and the footings of the largest steel installations.

- **Cuttings**

The drilling of both hydrocarbon and injection wells generates drill cuttings, which are particles of crushed rock produced by the action of the drill bit as it penetrates the earth. The chemical and mineral composition of drill cuttings reflects that of the rock layers penetrated by the drill. Cuttings contain the residues of the drilling fluids used in the wells, and in some cases also reservoir hydrocarbons. Cuttings piles arise from drilling operations where the drilled cuttings and associated drilling fluids are discharged at the location of the well and then accumulate depending on the water current in the region. It is more than 20 years since the discharge of organic-phase fluid-contaminated drill cuttings was prohibited, but historic cuttings piles are still present under some platforms. Such cuttings piles have been identified as a possible source of oil release into the marine environment, due to remobilisation of residues and natural leaching into the water column. Studies have shown that the leakage of oil from these cuttings piles is low, and their individual footprints are contracting due to natural degradation. However, concerns have been expressed about possible releases of oil, chemicals, and heavy metals from the disturbance of historic cuttings piles, either during decommissioning activities or from bottom trawling after decommissioning.

The discharge of cuttings drilled with water-based fluids and discharge of treated cuttings drilled with organic-phase fluids may cause sediment modification and some smothering in the near vicinity of the well location. The impacts from such discharges are localised and transient but may be of concern in areas with sensitive benthic fauna, for example corals and sponges.

- **Input or spread of non-indigenous species**

The introduction of hard substrates such as offshore installations and of protection material including sand, rock, gravel, and concrete mattresses facilitates the establishment of invasive species by providing stepping stones. However, healthy ecosystems established on/around installations may also offer protection against invasive species. This is further elaborated in the thematic assessment covering non-indigenous species. (See: Non-Indigenous Species Thematic Assessment)

- **Carbon dioxide storage**

The pressures from carbon dioxide storage, including development and decommissioning activities, could be similar to pressures from offshore oil and gas activities. There is the risk of carbon dioxide leakage from the storage site, which may have negative effects on the receptors in the marine environment, including the potential for ocean acidification if carbon dioxide leakage were to occur. While scientific knowledge of the environmental risks of carbon dioxide storage in geological formations is developing, the need for improving and refining the reporting to OSPAR on environmental monitoring of carbon dioxide storage projects has been identified.

S – State

The implementation of OSPAR measures has resulted in a measurable decrease in discharges and associated impacts

Oil and gas exploration and exploitation can lead to a range of impacts in the marine environment. The reported data and results of the environmental monitoring studies (Report on impacts of discharges of oil and chemicals in produced water on the marine environment and Assessment of the disturbance of drill cuttings during decommissioning) show that the implementation of OSPAR measures has resulted in a measurable decrease in discharges and associated impacts. This section presents an overview of studies of water column, sediments, physical impact, cuttings piles, decommissioning and light and noise effects.

Table S.1: Trends in impacts from oil and gas activities

	Arctic Waters (Region I)	Greater North Sea (Region II)	Celtic Seas (Region III)	Bay of Biscay and Iberian Coast (Region IV)	Wider Atlantic (Region V)
Trend since QSR 2010	↓	↓	↓	↓?*	↓

*Reported data for region IV is very limited, and the trends are therefore uncertain

Discharges and associated impacts in the water column

Water column impacts from discharges of produced water

Water column monitoring (WCM) has been carried out in the OSPAR area to determine the possible effects of discharges of produced water. The monitoring of toxic effects in the water column focuses on biomarkers in fish (especially cod and haddock) and blue mussels and aims to identify sensitive endpoints that can be linked to the exposure to produced water.

Norwegian WCM has found significantly higher concentrations of PAH and NPD (naphthalene, phenanthrene and dibenzothiophene) in caged mussels located 500 m from an offshore installation as compared to reference areas, and histopathological analyses have indicated a minor stress condition in caged mussels located 500 m and 1000 m from the platform. Thus, the worst-case exposure (500 m from the discharge point) has mainly confirmed the exposure through observation of a minor stress condition in the mussels. Increased levels of PAHs, alkyl phenols and measured biological responses also suggest exposure of wild fish. The combined exposure to the constituents in produced water may lead to a toxic effect on organisms in the sea. This is reflected in OSPAR Agreement 2012-7 on Guidelines in support of Recommendation 2012/5 for a Risk-based Approach to the Management of Produced Water Discharges from Offshore Installations which allows for risk to be estimated by either the whole effluent toxicity or by the (summed) toxicity of each substance.

Controlled laboratory experiments have shown that exposure of salmon and herring fry to low PAH levels (ng to µg per L) induces cardiac defects which impact the fish fry in several critical ways, including through reduced swimming performance and in prey capture and prey avoidance, with repercussions on survival and a possible impact on population level. Haddock has been observed to be more sensitive than cod when egg/embryo surface (chorion) is exposed to oil droplets.

Generally, however, the results obtained from field-realistic concentrations indicate that impacts are expected to be modest. The overall risk of produced water discharges exerting an adverse impact on populations of wild fish and other pelagic organisms is therefore expected to be low.

It is generally accepted that produced water effects are limited to areas where the produced water is diluted less than 1 000 times, roughly corresponding to distances less than 1 000 m from the discharge point, depending on the discharge rate, water depth, local currents, and other environmental factors. Based on laboratory results where the test organisms are exposed to constant concentrations over several days as well as studies with caged animals placed in the produced water plume, acute toxicity effects can be expected at such concentrations.

The monitoring of toxic effects in the water column focuses on biomarkers in fish (especially cod and haddock) and blue mussels (*Mytilus edulis*) and aims to identify sensitive endpoints that can be linked to exposure to produced water. The Research Council of Norway concluded in 2012 that toxic effects such as cell death, genetic change, DNA damage, a change in fatty acid composition and interference with reproduction is detected at concentrations of produced water at 0,1-1% or higher, i.e., when the produced water has been diluted less than 100-1 000 times. Moreover, the focus of the testing of produced water effects has recently shifted towards the possible effects of chronic, low-concentration exposures to sensitive endpoints and to life stages of marine species such as early life and sexual maturation.

However, a constant exposure scenario is improbable, because an organism is unlikely to be exposed for days to static concentrations. Drifting plankton (including fish eggs) passing the discharge point may be exposed to high produced water concentrations, but because of dispersion and dilution the exposure duration is short. For adult fish, the effect or accumulation of produced water constituents have not been demonstrated in wild animals caught in produced water-influenced areas, perhaps because they can avoid polluted areas. This does not mean that laboratory results should be disregarded, especially when the exposure concentrations correspond to dilutions of 1 000 times or more. While effects at these low concentrations are observed after weeks of continuous exposure, this is unlikely under dynamic environmental conditions. Also, sessile organisms are expected to experience constantly high pollution levels only rarely, as the direction of a pollution plume changes with the tide, currents, and wind.

Despite the large volumes of produced water released, the effects of the constituents appear to be low and mainly seen at biomarker level. However, the causality between biomarkers and toxic effects and impact at the organism and population levels remains to be proven. Other anthropogenic factors are difficult to exclude when assessing the impact of produced water in marine ecosystems. While the conclusions from OSPAR's Quality Status Report 2010 are still valid, it should be emphasised that this does not imply that no causal relationships exist between impacts at organism level and impacts at population or ecosystem level. It should only be seen as an indication that there is a lack of evidence and that further investigations are needed to establish whether such relationships exist.

Discharges of produced water can occasionally lead to the formation of oil sheens at the sea surface, especially in calm weather conditions. Investigations of produced water discharges to date have not included possible effects of such oil sheens. Assessing the extent and possible effects of oil sheens originating from discharges of produced water has been identified as a task that needs to be addressed in the coming years.

Water column impacts from contaminants released from cuttings piles

Monitoring undertaken near cuttings piles historically contaminated with organic-phase fluids indicates that the concentration and spatial extent of the contamination have been reduced and leaching rates diminished since the initial discharge.

Based on the case studies reviewed (OIC 2014) the majority of impacts from cuttings piles have been noted within 100 m of the centre of the pile; generally, beyond 500 m there is little discernible impact. When cuttings piles are disturbed, the pile is aerated, allowing some additional degradation to take place. However, this disturbance results in additional, albeit generally short-term and localised, impacts on the water column, and in some (not all) cases could cause contamination of the seabed outside the areas impacted by the original cuttings discharge.

Fishing may be able to resume over cuttings piles previously contained in a 500 m safety zone where fishing activities would have been excluded. Where cuttings are left in situ or relocated on the seabed there is the potential for trawling activities to disturb the cuttings pile, resulting in the contaminants contained within the cutting pile being released into the water column, as well as the potential for the nets and catch to be contaminated.

Water column impacts from accidental spills

Accidental spills of oil and chemicals may have an impact on the marine life in the upper water column, including mammals and seabirds. The level of impact arising from an oil spill is dependent on the location and size of the spill and when it occurs. Assessment of the environmental effects following the 2012 Elgin platform incident in the United Kingdom which resulted in the release of gas / condensate have shown that dispersion and evaporation of the gas/condensate occurred within hours of its release, with the sheen never travelling further than 60 km from the platform's location. Environmental surveys following the incident have found no evidence of significant effects on the water column, fish or seabed from the condensate or water-based mud (WBM). There was also no evidence of significant mortality among either birds or marine mammals during or after the incident, and the hydrocarbons did not beach. There is no evidence that accidental spills of chemicals significantly impact the water column.

Impact of discharges on sediments

Impacts of discharges of drilling fluids and contaminants released from historic cuttings piles

As a result of contamination by organic-phase fluids and the settlement of suspended fine cuttings, benthic fauna become stressed. This results in lower diversity and the dominance of tolerant opportunistic species in several square kilometres around the well location. Since the ban on the use of diesel oil-based drilling fluids and the prohibition on the discharge of untreated cuttings contaminated with organic-phase drilling fluids, and after the substitution of most of the hazardous chemicals with less hazardous substances, the impact has significantly reduced. Studies have shown that at the peak of discharge of oil-contaminated cuttings, fauna disturbance could be found at more than 5 km from some platforms, but it is now seldom detected beyond 500 m.

Although it is more than 20 years since the discharge of cuttings contaminated with organic-phase fluids was prohibited, historical cuttings piles are still present beneath some installations. Monitoring undertaken near cuttings piles historically contaminated with organic-phase fluids indicates that the concentration and spatial extent of contamination have been reduced and that leaching rates have diminished since the initial discharge. The 2009 OSPAR Assessment of impacts of offshore oil and gas activities in the North-East Atlantic concluded that disturbance of cuttings piles does not result in significant impacts on the marine environment. Further studies conducted in 2014 (OIC 2014) and 2017 (OIC 2017) and new data support that conclusion: no significant effects on the seabed have been observed, although there may be a temporary effect on the water and sediment quality near the site of the disturbance.

The discharge of drill cuttings and water-based fluids may cause some smothering in the near vicinity of the well location. Water-based cuttings may affect biomarkers in filter feeding bivalves and cause elevated sediment oxygen consumption and mortality in benthic fauna. Effects levels occur within a 0,5-1 km distance and the stress is mainly physical. The impacts of such discharges are localised and transient but may be of concern in areas with sensitive benthic fauna, for example corals and sponges.

Impacts of discharges from produced water on sediments

It is generally to be expected that produced water is diluted in the water phase. However, the hydrophobic chemicals in it may adsorb to the sediment, especially in shallow water or under downward trajectory of the produced water plume.

Sediment monitoring has been performed by several Contracting Parties. Both Danish and Norwegian studies have found that the concentration in sediments of petrogenic PAH increases in the areas close to the platforms. Biological diversity and evenness were studied in samples from the Danish platforms, and changes to seabed fauna and quality were found to be local and short-term; the seabed was found to be resilient to disturbances associated with oil and gas operational discharges. The results of the seabed monitoring do not indicate that discharges of produced water in general have an impact on the seabed, since the probability of such an impact will, by its nature, be less likely with increasing distance and depth from where the discharges take place.

Physical impacts on the seabed

Contracting Parties do not undertake extensive monitoring programmes to assess the physical impacts of the placement of structures on the seabed. Historical monitoring has demonstrated that the impacts are largely transient, with recolonisation of disturbed seabed habitats occurring within relatively short time scales.

The creation of hard bottom substrate can, over time, give an opportunity for new benthic species to colonise the former sandy / muddy areas. Pipelines, platform legs and subsea templates may act as shelter for fish and other mobile marine organisms and provide a habitat for benthic organisms usually associated with hard substrates.

Benthic communities will be impacted for a variable period of time. In areas of soft sediments, where most pipelines are trenched and buried, the soft bottom fauna recolonises within a year or two. In areas of harder substrates, the recovery of benthic communities may take longer, up to 10 years in deeper and colder water. There are few pipelines that are trenched and buried in these areas. In impacted areas a gradual change occurs in the species composition of benthic communities until equilibrium is achieved, depending on the new local conditions. During the re-establishment of the area, it is also possible that specific diversity will increase due to the colonisation of hard structures by previously absent benthic species.

Impact from decommissioning of offshore installations

OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations prohibits the dumping, and the leaving wholly or partly in place, of disused offshore installations within the OSPAR Maritime Area. It is possible to seek derogation to this Decision if it can be demonstrated that there are significant reasons why an alternative disposal option is preferable. The majority of installations are removed at the time of decommissioning. Reviews of the experience and technical developments relating to the decommissioning of platforms were undertaken in 2013 and 2018. The reviews showed that the number of projects involving concrete structures and substantial steel footings has been very low and that there have been no significant developments in the technical capabilities of the industry which would support a reduction in the categories eligible for derogation. However, as older installations reach their end-of-life, it is anticipated that a number of installations will be decommissioned in the coming decade. Therefore, the 2018 review also agreed that Contracting Parties and Observer Organisations should proactively promote areas of research and scientific understanding so as to provide a wider scope for the upcoming review of derogation categories in Annex 1 of Decision 98/3 to be conducted in 2023.

In the light of experience with the decommissioning of offshore installations, relevant research and the exchange of information, OSPAR aims to ensure that derogations from the dumping ban remain exceptional.

During 2019 to 2020 a consultation process was undertaken under OSPAR Decision 98/3 concerning the United Kingdom’s intention to issue a derogation so as to leave in situ the footings of the Brent Alpha Steel Jacket and Brent Bravo, Brent Charlie and Brent Delta gravity-based concrete installation structures. A Special Consultative Meeting was held in London in October 2019 to discuss the objections raised to the derogation proposal with reference to comparative assessment methodology, long-term risk to the marine environment from the residues in the storage cells and the risk posed by the gravity-based concrete installation legs to shipping and fishing. The meeting agreed that, in view of the upcoming decommissioning projects, the process presented an opportunity to agree on common OSPAR standards for comparable challenging decommissioning cases.

Impact of platform lighting on birds

According to the research into possible effects of offshore platform lighting on specific bird populations (2012 OSPAR Workshop), there is evidence that the conventional lighting on some offshore installations has had an impact on a large number of birds. The evidence is, however, not sufficient to conclude whether or not there has been a significant effect at the population level (E. van der Zee, 2014).

Impact of noise on fish and marine mammals

The potential effects from noise vary depending on the sensitivity of the receptor and its proximity to the sound source. There is potential for increased mortality among juvenile stages of fish, permanent or temporary hearing impairment and the displacement of fish and marine mammals from their normal range (OSPAR, 2009a). There is evidence for several species of cetaceans to suggest avoidance over distances, most commonly around 2-5 km from the seismic survey vessel. Changes in acoustic communication have been recorded at much greater distances (up to several hundred km), but there is a lot of uncertainty with regard to the biological significance of these observations. Relatively limited evidence is available for harbour porpoises or other species common in the North Sea; as a conservative assessment, it is reasonable to assume that the firing of airguns during seismic surveys will affect individuals within 10 km of a survey vessel, resulting in changes in distribution and a reduction in foraging activity, although this effect is short-lived.

The impacts of seismic surveys on fish have been shown to include an increase in fish mortality at less than 5 m from the sound source, and temporary threshold shifts, and behavioural responses have also been reported. Evidence from the North Sea indicates potentially large-scale avoidance of areas where seismic surveys are being undertaken, with fish either moving into deeper water or avoiding the area altogether. Experiments undertaken in the North Sea on sand eels have indicated relatively minor responses to seismic surveys and no increases in mortality.

I – Impact (on Ecosystem Services)

Ecosystem services impacted by oil and gas

As shown schematically in **Figure I.1**, each state change/environmental impact associated with the oil and gas industry and carbon dioxide storage will affect a range of different ecosystem services. The specific impact on each ecosystem service is further elaborated in the following text.

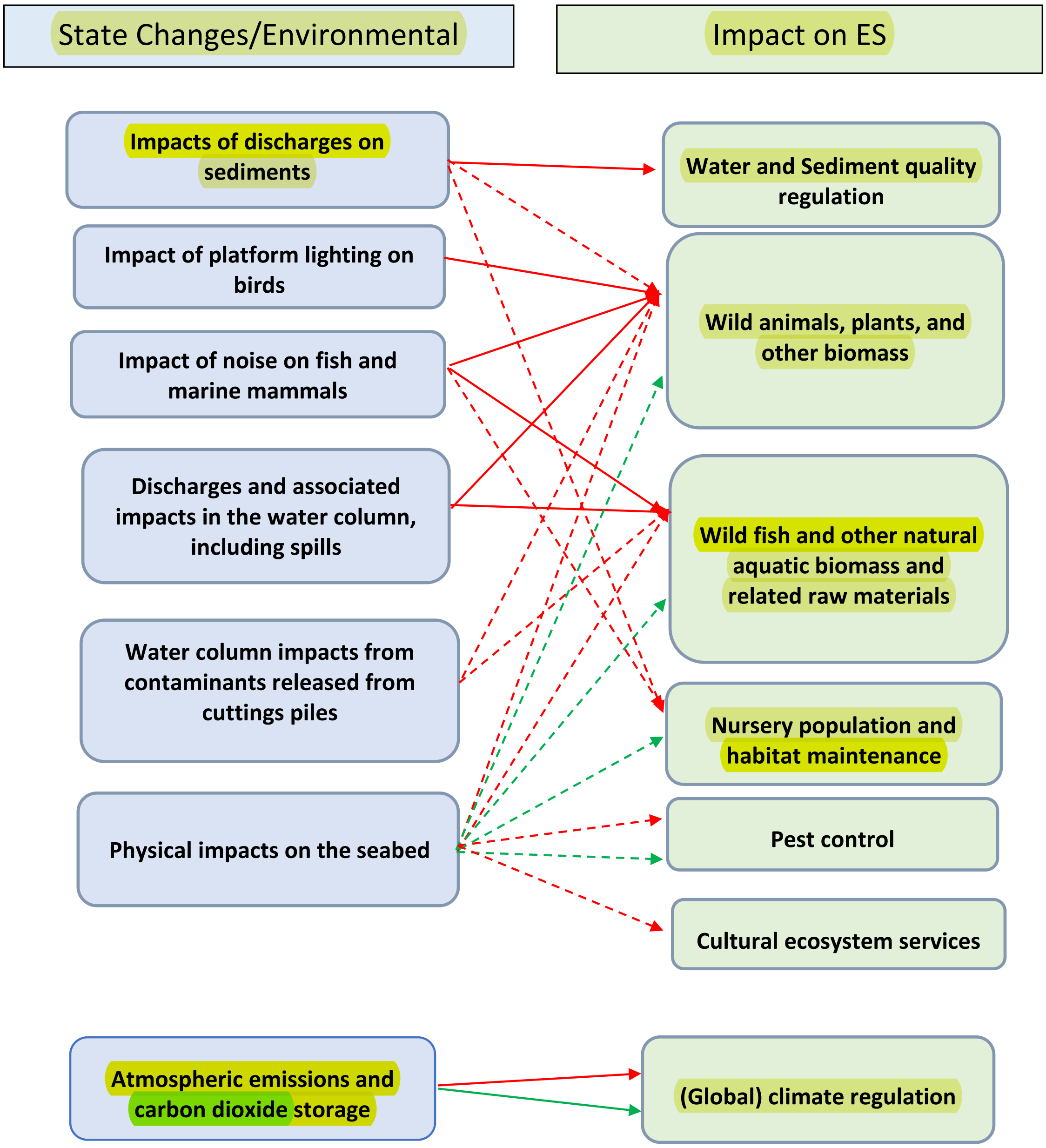


Figure I.1: Impact of state changes on different ecosystem services

Wild fish and other natural aquatic biomass and related raw materials

The discharge of produced water could expose fish and other aquatic biomass to contaminants. This could potentially affect the biomass provisioning service from wild fish and other natural aquatic biomass and community functions such as reproduction. Among the fish species potentially most impacted, at biomarker level, are demersal species such as cod and haddock. Results obtained in studies with field-realistic concentrations indicate that impacts are expected to be modest. The overall risk of produced water discharges exerting an adverse impact on populations of wild fish and other pelagic organisms is therefore expected to be low.

The possible release of oil and chemicals from the disturbance of old cuttings piles, either through decommissioning activities or from bottom trawling after decommissioning, could also expose fish or other aquatic biomass to contaminants. This disturbance results in additional, albeit generally short-term and localised impacts on the water column, and in some (not all) cases could cause contamination of the seabed outside the areas impacted by the original cuttings discharge. Fishing may be able to resume above cuttings piles previously contained in a 500 m safety zone where fishing activities would have been excluded.

It is believed that the physical presence of offshore installations can contribute to biomass production. This ability to contribute to the biomass provisioning service is supported by the intermediate ecosystem service of nursery population and by the habitat refuge provided by the offshore installations, which offer protection against invasive species. This in turn can be assumed to have a relatively small positive effect on the very biomass that makes up the marine food web, i.e., the ecosystem service comprising wild animals, plants, and other biomass.

Noise from seismic surveys can also potentially harm fish, with effects varying greatly from very subtle behavioural changes and avoidance reaction to hearing loss, injury and death in extreme cases.

Ecosystem services impacted by underwater noise associated with the oil and gas industry For more details on the environmental impacts associated with underwater noise (mainly impulsive noise when it comes to the oil and gas industry) and the resulting impacts on ecosystem services see the Underwater Noise Thematic Assessment.

Wild animals, plants, and other biomass

The construction, operation and decommissioning of pipelines and offshore installations, the discharge of cuttings drilled with water-based mud and disturbance to historic cuttings piles can have a localised and transient negative effect on benthic organisms and could alter the local food web, particularly in aggregations of deep-sea corals and sponges.

Platform lighting and flaring are also known to attract birds, and might cause some mortality in migratory species. The level of impact depends on the location of the platform, the time of year and the prevailing weather conditions, with birds being most frequently attracted during the autumn migration and in poor weather.

Anthropogenic noise introduced to the marine environment can potentially affect marine mammals in various ways and alter prey / food availability. The nature of the effects reviewed range widely, from masking of biological communication and small behavioural reactions to chronic disturbance, injury, and mortality. Noise can also potentially harm fish, with effects varying greatly from very subtle behavioural changes and avoidance reaction to hearing loss, injury, and death in extreme cases.

(Global) climate regulation

Atmospheric emissions from the oil and gas industry have a negative impact on climate regulation services by adding CO_2, methane, and NMVOCs to the atmosphere.

Carbon dioxide capture and storage in geological formations is expected to contribute to reducing CO_2 emissions.

Sediment quality regulation and water quality regulation

The construction, operation and decommissioning of pipelines and offshore installations, the discharge of cuttings drilled with water-based mud and disturbance to historic cuttings piles can have a localised and transient negative effect on benthic organisms. This could potentially affect sediment reworking (bioturbation), filtering organisms and sediment microbial organisms to some extent, which in turn could affect the sediment and water quality regulation service provided by these organisms. The effects on the water column are expected to be local and modest, according to the results of water column monitoring.

Despite the large volumes of produced water discharged, the effects appear to be low and mainly seen at biomarker level. However, the causality between biomarkers and toxic effects and impact at organism and population levels remains to be proven. It should be emphasised that this does not imply that no causal relationships exist between impacts at organism level and impacts at population or ecosystem level. It should only be seen as an indication that there is a lack of evidence and that further investigations are needed to establish whether such relationships exist. They may affect the regulation of both sediment quality and water quality,

Pest control

The potential role of offshore installations (and associated protection material including rock and concrete mattresses) in facilitating the establishment of invasive species by acting as stepping stones is recognised (Fowler *et al.,* 2018). There is also a risk of spreading invasive species when installations are moved to shore after decommissioning. Healthy ecosystems established on and around installations may on the other hand offer protection against invasive species.

For more details on the environmental impacts associated with non-indigenous species and the resulting impacts on ecosystem services, see the Non-Indigenous Species Thematic Assessment.

Nursery population and habitat maintenance

The construction, operation and decommissioning of pipelines and offshore installations and discharges of drill cuttings can have a localised negative impact on megafauna communities, for example by reducing sponge density and diversity. Similarly, seabed disturbance can possibly affect burrowing species and the spawning grounds of bottom spawning fish. This may have the localised effect of reducing habitat maintenance services. Offshore installations can also act as a refuge, providing habitats which offer opportunities for shelter, refuge from predators, and foraging.

Noise from seismic surveys can also possibly negatively affect the breeding areas of marine mammals and fish spawning areas.

Cultural ecosystem services

In relation to the offshore industry, as with most OSPAR pressure-based thematic assessments, assessing cultural ecosystem services and the impacts on them is challenging, due to the fact that cultural ecosystem services rely heavily on personal preferences that will undoubtedly polarise opinions. The very existence of offshore installations and activities close to shore, as well as the risk of accidents, can influence, for example, people's spiritual connection to the ecosystem.

The physical presence of offshore installations close to shore may affect the wellbeing derived from seeing a pristine seascape, and may adversely affect spiritual, artistic, symbolic, and visual amenity services, in turn affecting the sensory and/or visual perception of the people who benefit from them. However, there are very few offshore installations close to shore (e.g., the eastern Irish Sea, United Kingdom, and the Schleswig-Holstein Wadden Sea, Germany) in the OSPAR Maritime Area.

A number of spills of oil and chemicals from offshore oil and gas operations have been recorded in the OSPAR Maritime Area. Accidental spills of oil and chemicals may have an impact on marine life. While the nature and extent of the spills from offshore industry to date in the OSPAR Maritime Area have been limited, with a few exceptions the available evidence indicates that the impacts on ecosystem services have also been limited. However, depending on time (season), and location, it is acknowledged that an accidental spill could have a significant effect on cultural ecosystem services, such as ecosystem and species appreciation, and spiritual, artistic, symbolic, and visual amenity services.

Ecosystem services impacted by marine litter associated with the oil and gas industry

For more details on the environmental impacts associated with marine litter and the resulting impacts on ecosystem services see the Marine Litter Thematic Assessment.

R – Response

OSPAR measures

OSPAR has put in place a significant number of measures aimed at reducing emissions and discharges from the oil and gas industry within the OSPAR Maritime Area. The vast majority of these have been made since 2000 and aim to reduce the environmental impacts of the industry on the marine environment. Measures introduced by OSPAR have reduced oil in produced water discharges and the use and discharge of chemicals and drilling fluids. OSPAR has, with a few exceptions, effectively prohibited the disposal of disused offshore installations at sea. A summary of these measures is detailed below and a progress report on the implementation of all OSPAR measures is available at: Implementation of OSPAR Measures: A Progress Report. Other international measures are also in effect, and these are mentioned under each area of regulation below.

Evidence from monitoring and reporting of oil and gas activities indicates that the overall effect of these OSPAR measures and their implementation by Contracting Parties has been to significantly improve the overall quality status of the OSPAR Maritime Area as a whole, particularly in areas of Region II where there are high levels of oil and gas activity.

Measures to reduce the effects of produced water discharges

Dispersed oil is discharged into the OSPAR Maritime Area in accordance with **OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations (as amended)**, which seeks to limit the concentration of dispersed oil in produced and displacement water discharges to no more than 30 mg/l, calculated as a flow weighted monthly average. The Recommendation also calls for a reduction in the total oil discharged into the sea in 2006 by 15% compared to the equivalent discharge in the year 2000, which has been achieved. The concentration of dispersed oil is determined in accordance with the OSPAR reference method. The amount of dispersed oil discharged in 2019 was 16% below that discharged in 2009.

In 2012, **OSPAR Recommendation 2012/5 for a Risk-based Approach to the Management of Produced Water Discharges from Offshore Installations** was adopted. Contracting Parties provided the OIC with implementation plans in 2013 and the majority commenced assessments in 2014, with the Recommendation due to be fully implemented by 2018. To date, 54% of the installations have been determined as having their discharge under adequate control, 39% require further action to be taken, and the remainder are still under assessment.

Measures to reduce the use and discharge of chemicals

In 1996, OSPAR's predecessor, PARCOM, adopted Decision 1996/3 on a Harmonised Mandatory Control System for the Use and Reduction of Discharge of Offshore Chemicals (HMCS). Following a trial period, its effectiveness was reviewed and a package of new OSPAR measures established, and OSPAR then adopted **Decision 2000/2 on a Harmonised Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals**, **(HMCS Decision) (as amended)**. The purpose of the Decision is that authorities must, by applying the management mechanisms set out, ensure and actively promote the continued shift towards the use of less hazardous substances (or preferably non-hazardous substances) and, as a result, the reduction of the overall environmental impact resulting from the use and discharge of offshore chemicals.

The HMCS Decision, along with **OSPAR Recommendation 2017/1 on a Harmonised Pre-Screening Scheme for Offshore Chemicals (as amended)** and **OSPAR Recommendation 2010/3 on a Harmonised Offshore Chemical Notification Format (HOCNF) (as amended)** is a key element in OSPAR's control of offshore chemicals. It sets out, inter alia, what kind of data and information must be notified to the national competent authorities of the Contracting Parties. For each chemical, it provides advice to be taken into account by the competent authorities with the aim of harmonising authorisation and permitting procedures for chemicals among the Contracting Parties. The measures also include more detailed guidance on the substitution and ranking of chemicals.

OSPAR identifies substances that pose a risk to the marine environment and maintains the List of OSPAR Chemicals for Priority Action (LCPA) and the List of Substances of Possible Concern (LSPC). These lists are undergoing substantial review and revision in 2021/22.

OSPAR measures such as the harmonised approach to the management of offshore chemicals, the harmonised notification format and the harmonised pre-screening procedures for offshore chemicals, and OSPAR's efforts to increase harmonisation between the HMCS and EU REACH continue to ease the work of both the national competent authorities and the industry, and have made regulatory decisions related to the use and discharge of offshore chemicals within the OSPAR Maritime Area more transparent.

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 (LCPA) set environmental goals for the reduction of substances on the LCPA, with the aim of phasing out these discharges by 2010; this was achieved in 2014. According to the Recommendation, competent authorities should not issue new authorisations for the discharge in the OSPAR Maritime Area of offshore chemicals that are, or which contain added substances listed in the LCPA, unless those offshore chemicals have already been notified for offshore use prior to that Recommendation taking effect.

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 (as amended) sets out environmental goals on the phasing out of discharges of offshore chemicals that are, or which contain substances identified as candidates for substitution[1] by 2017. The purpose of the Recommendation is to set an environmental goal for offshore chemicals that are, or which contain substances identified as candidates for substitution, in order to move towards the cessation of these discharges from offshore installations by 2026. Almost half of the reduction in the use and discharge of substances carrying

1 Except for those chemicals where, despite considerable efforts, it can be demonstrated that this is not feasible due to technical or safety reasons. Demonstration of those reasons should include a description of the efforts.

substitution warnings can be directly attributed to the implementation of OSPAR Recommendation 2006/3. The Recommendation was amended in 2019 to include a new substitution deadline.

Measures to reduce impacts from discharges of drilling fluids

The use of diesel-oil based drilling fluids was prohibited by OSPAR from 1 January 1987 and the discharge of untreated cuttings contaminated with oil-based drilling fluids ceased following the adoption of PARCOM Decision 92/2 on the use of oil-based muds. Following the adoption of **OSPAR Decision 2000/3 on the Use of Organic-Phase Drilling Fluids and the Discharge of Organic-Phase Fluid Contaminated Cuttings**, the discharge into the sea of whole organic-phase fluids and of cuttings contaminated with organic-phase drilling fluids at a concentration greater than 1% by weight on dry cuttings has been prohibited since 2001. Cuttings contaminated with organic-phase fluids can only be discharged in exceptional and very rare circumstances of force majeure. The use of organic-phase fluids is not prohibited as it is required in the lower sections of most wells. Prior to any usage, national authorisation is required.

Measures to reduce discharge of plastics and microplastics

Following concerns about the potential discharge of lost circulation materials containing plastics, the OIC in 2013 agreed to prohibit the discharge of lost circulation material containing plastics and also agreed that if zero discharge of lost circulation material containing plastic materials could not be guaranteed, the material should not be permitted for use. In 2019, **OSPAR Recommendation 2010/3 on a Harmonised Offshore Chemical Notification Format** was amended to include checks on whether a substance is plastic, microplastic or nanomaterial, with a view to establishing further control measures. The amendment is expected to provide data in the coming years, which will help determine if additional control measures will be needed.

Measures for management of historic cuttings piles

The purpose of **OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles** is to reduce the impacts of pollution by oil and/or other substances from cuttings piles to a level that is not significant. In accordance with OSPAR Agreement 2002-08 on Guidelines for the Consideration of the Best Environmental Option for the Management of Organic-Phase Fluids Contaminated Cuttings Residue , Contracting Parties undertook screening assessments at specific locations. The assessments indicated that no immediate action was required to reduce the environmental impact of any of the cuttings piles and that their management could be addressed as part of the installation decommissioning activities.

Physical impact from offshore activities

Over the years there has been an improvement in the technology involved in the placement of infrastructure on the seabed and greater awareness of the potential environmental impacts that this may cause. For example, the extensive use of Remotely Operated Vehicles (ROVs) and the use of multibeam and side scan sonar mapping makes it easier to find the best transects and avoid the disturbance of vulnerable marine communities. Similar improvements in pile-driving techniques and pipeline laying methodologies have contributed to limiting the potential environmental impacts. Assessment of the direct physical impact of placing a structure on the seabed is addressed within the relevant environmental statement and the associated environmental impact assessment under the relevant national legislation. Environmental monitoring of the physical impacts that arise from placing a structure on the seabed is undertaken on a case-by-case basis depending on the particular sensitivities associated with the area. The monitoring of pipelines is routinely undertaken by developers to ensure that the integrity of the pipeline is being maintained. The results from such surveys can also provide useful information on the physical impact of the laid pipeline and information on the marine fauna that thrive there.

Data on pipelines decommissioned in situ has mainly been collected by the United Kingdom, with limited data inputs from Denmark, the Netherlands, and Norway. As a result, most of the analysis has focused on United Kingdom data.

Together, these four countries account for over 400 pipelines decommissioned in situ, with a total length of just under 3 600 km. In the United Kingdom, 207 pipelines have been left in situ, totalling 1 833 km. This represents approximately half of the pipelines decommissioned to date (data to the end of October 2018). In terms of space occupied on the seabed, all of the pipelines decommissioned in situ represent a very small proportion of the United Kingdom Continental Shelf (0,002%).

Regulation of accidental spills

OSPAR does not specifically regulate for accidental spills but international measures such as the International Convention on Oil Pollution Preparedness, Response and Co-operation and specific national legalisation on the prohibition of spills of oil and chemicals is in place in Contracting Parties' jurisdictions. Following the Deepwater Horizon disaster in the Gulf of Mexico in 2010, OSPAR introduced **Recommendation 2010/18 on the prevention of significant acute oil pollution from offshore drilling activities,** which required Contracting Parties to review their existing frameworks, including those for permitting drilling activities in extreme conditions, and to report back to the OIC. In the light of EU Directive 2013/30/EU on Offshore Safety it was agreed there was no need for a further OSPAR measure to cover major accident prevention. Contracting Parties attend other established forums which deal with this topic, for example the North Sea Offshore Authorities Forum, the International Regulators Forum, and the EU Offshore Authorities Group.

While ageing installations may be a factor affecting the risk of accidental spills, the main factors in spill prevention are ensuring barrier effectiveness through maintenance programmes, developing handling procedures to minimise the potential for spills, and staff training and competence management to ensure that environmental risks are managed. Since 2000, there has been a greater awareness in the industry of the need to report all spills irrespective of spill size, and such requirements have resulted in increased reporting and greater environmental awareness. All operators are also encouraged to have an environmental management system that accords with **OSPAR Recommendation 2003/5 to Promote the Use and Implementation of Environmental Management Systems by the Offshore Industry (as amended),** and such management systems are required to consider how installations can be operated to minimise impact on the environment, including by preventing spills.

Regulation of atmospheric emissions

OSPAR does not specifically regulate atmospheric emissions from the oil and gas industry. However, there are a number of relevant EU Directives and international conventions which apply to OSPAR Contracting Parties. Since 2009 there has been a significant change in the way atmospheric emissions are managed, through ongoing strengthening of the European Union Emissions Trading Scheme (EU-ETS), the Industrial Emissions Directive (2010/75), the Medium Combustion Plant Directive (2015/2193) and the Sulphur Content Directive (2012/33). There have been overall reductions in all reported atmospheric emissions across the OSPAR area over the last 10 years, most significantly in methane and SO_2 emissions. National legislation by some Contracting Parties has also sought to reduce emissions of nitrous oxides.

Measures to mitigate impacts from decommissioning

The 1998 OSPAR Ministerial Meeting in Sintra, Portugal, adopted **OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations,** which prohibits the dumping, and leaving wholly or partly in place, of disused offshore installations within the OSPAR Maritime Area. Only for certain categories, and subject to an assessment in Annex 2 of Decision 98/3, may the competent authority of the relevant Contracting Party issue a permit to leave installations or parts of installations in place (for example steel installations weighing more than 10 000 tonnes in air or gravity-based concrete installations). Before a decision is taken to issue a permit, the relevant Contracting Party shall first consult the other Contracting Parties in accordance with Annex 3 of Decision 98/3.

Since the ban on dumping of disused offshore installations came into force in 1999, 170 offshore installations have been brought ashore for disposal. There are 59 steel installations with a substructure weighing more than 10 000 tonnes and 22 gravity-based concrete installations for which derogations from the dumping ban may be considered. Ten derogations have been issued since 1999 by Contracting Parties for structures to be left in place (five concrete substructures and the footings of five large steel structures). In addition, the Piper Alpha installation was abandoned in situ following the disaster in 1988.

During 2019 to 2020 a consultation process was held under OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations concerning the United Kingdom's intention to issue a derogation for leaving in situ the footings of the Brent Alpha Steel Jacket and the Brent Bravo, Brent Charlie and Brent Delta gravity-based concrete installation structures. A Special Consultative Meeting was held in London in October 2019 to discuss the objections raised to the derogation proposal, with reference to comparative assessment methodology, long-term risk to the marine environment from the residues in the storage cells and the risk that gravity-based concrete installation legs pose to shipping and fishing. In view of the upcoming decommissioning projects, the process was considered as presenting an opportunity to agree on common OSPAR standards for comparable challenging decommissioning cases.

An informal meeting to discuss comparative evaluation of decommissioning options in support of derogation proposals was held in December 2019 following proposals to develop a joint comparative assessment methodology for application across OSPAR Maritime Area in compliance with OSPAR Decision 98/3. One of the outcomes of the meeting was an agreement that, in order to improve the advancement of technology and maintain focus, Contracting Parties and Observer Organisations would give an annual update on progress made in decommissioning technology developments so as to help reduce the number of derogation categories. This was endorsed by OIC 2020.

Guidelines to reduce effects from light on birds

In OIC 2015, the Guidelines to reduce the impact of offshore installation lighting on birds in the OSPAR Maritime Area (OSPAR Agreement 2015-08) were adopted. These guidelines provide advice for OSPAR Contracting Parties considering the course of action to take to address the potential impact on birds of the conventional lighting on offshore installations. The guidelines are not intended to be prescriptive. They offer guidance based on discussions at the 2012 OSPAR Workshop aimed at reducing potential lighting impacts on migrating birds and seabirds. The guidelines apply to both existing and new offshore installations. Whether a proposal is more practicable on existing or new offshore structures will need to be determined on a case-by-case basis, and all proposals will need to take account of compliance with national and international regulations on aviation and shipping. Furthermore, proposals must not compromise safe working practices for personnel and processes. On new installations, potential mitigation measures should be considered as part of the design process.

The guidelines also require Contracting Parties to inform each other of developments. Contracting Parties provide biennial updates to the OIC on efforts being made to reduce the impact of offshore installation lighting on birds in the OSPAR Maritime Area. The Netherlands has reported that in the Dutch part of the North Sea an operator developing a new platform proposes to implement the following measures:

• Automatic on / off switching in areas of the platform where safety is not compromised;

• Full shutdown during the night in areas of the platform where safety is not compromised.

Germany has reported that in 2010 in the German part of the North Sea an operator implemented the following measures to reduce emissions from platform lighting:

- Wherever possible light sources are dismantled;
- Of the remaining lamps, only very few are in non-stop operation. The remaining lamps are only switched on when required via the process control system;
- The light sources have been ideally positioned to minimise the light emanated into the areas surrounding the platform.

The United Kingdom and Norway have reported that the operators of existing offshore installations continue to be encouraged to implement measures to reduce lighting attraction, and that appropriate measures will be implemented for new installations through the Environmental Impact Assessment process.

Birds in close proximity to offshore platform. © Shutterstock

Measures to mitigate the effects from noise

While there are difficulties associated with quantifying the occurrence, scale, and extent of the potential impacts of underwater noise, sowing to the great variability in the characterisation of sound relating to noise-generating activities, the propagation of the sound and the sensitivity of different species to measured and estimated sound levels, progress in improving understanding has been made on all these fronts. However, the relatively intense concentrations of anthropogenic activities in some parts of the OSPAR area, especially in Regions II and III, and the probability that the level of these activities will increase, makes it important to improve understanding of the potential effects of the most significant sources of underwater noise: seismic surveys, pile driving and the use of explosives.

Wide-ranging studies on noise impacts related to offshore oil and gas activities, mainly covering seismic surveys, pipelay noise and piling, have been reported by Contracting Parties. Details of these studies were presented at OIC 2015. A summary of the impacts on marine mammals, fish and other species was also included in the OIC 2016 Inventory of Measures and Techniques to Mitigate the Impact of Seismic Surveys.

Some noise-generating activities such as seismic surveys are subject to Environmental Impact Assessment, including noise assessment under relevant national legislation. In the case of oil and gas activities, a number of guidance documents have been published to assist developers and regulators with the consent process. Mitigation measures have been developed and implemented for seismic surveys. They include the avoidance of undertaking work during specific periods, the application of a soft-start procedure (gradually increasing the sound level to provide animals with time to leave the impact area), and the use of observers to scan a safety zone where no marine mammals should be present prior to the commencement of activities. However, the application of these measures is likely to be very varied within the OSPAR area, as guidelines to prevent or minimise the impact of noise on marine mammals currently vary and there is international recognition of the need for more consistent evidence-based guidance.

Storage of carbon dioxide

In order to allow the storage of carbon dioxide in geological formations, Contracting Parties to the OSPAR Convention adopted amendments to Annexes II and III to the OSPAR Convention in 2007. To ensure environmentally safe storage of carbon dioxide streams in geological formations, the **OSPAR Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations** was adopted in 2007 along with the OSPAR Guidelines for Risk Assessment and Management of Storage of CO_2 Streams in Geological Formation (Agreement 2007-12). Furthermore, the Contracting Parties also adopted **OSPAR Decision 2007/1 to Prohibit the Storage of Carbon Dioxide Streams in the Water Column or on the Seabed**, because of the potential negative effects.

There are only two full-scale projects on carbon dioxide storage in the OSPAR area. Due to this very limited number, an evaluation of the effectiveness of OSPAR Decision 2007/2 has not yet been undertaken.
The need to improve the reporting to OSPAR on environmental monitoring from carbon dioxide storage projects has been identified, and work has been initiated by OSPAR's Environmental Impacts of Human Activities Committee (EIHA) and the OIC to analyse the existing reporting obligations stemming from OSPAR and other national and international measures with a view to ensuring that adequate monitoring and reporting is undertaken. **According to NEAES S12.03,** OSPAR will by 2024 review the results of monitoring that is undertaken in relation to carbon dioxide storage to assess whether the monitoring techniques deployed are adequate to demonstrate that carbon dioxide streams are retained permanently in the storage complex. By 2026 OSPAR will evaluate the effectiveness of OSPAR measures to ensure that carbon dioxide streams are retained permanently in the storage complex and will not lead to any significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area.

Future priorities for OSPAR

Since QSR 2010, and following the implementation of OSPAR measures by Contracting Parties and industry, the oil and gas industry has made measurable progress and improvements in reducing its environmental impact. However, there are areas where it may be possible to further reduce the potential impacts. Specifically:

While progress has been made in reducing the use and discharge of chemicals identified as candidates for substitution since the introduction of OSPAR Recommendation 2006/3, the challenge remains to phase out discharges of substitution chemicals. OSPAR has set out Operational Objectives in S2.O3 in NEAES 2030.

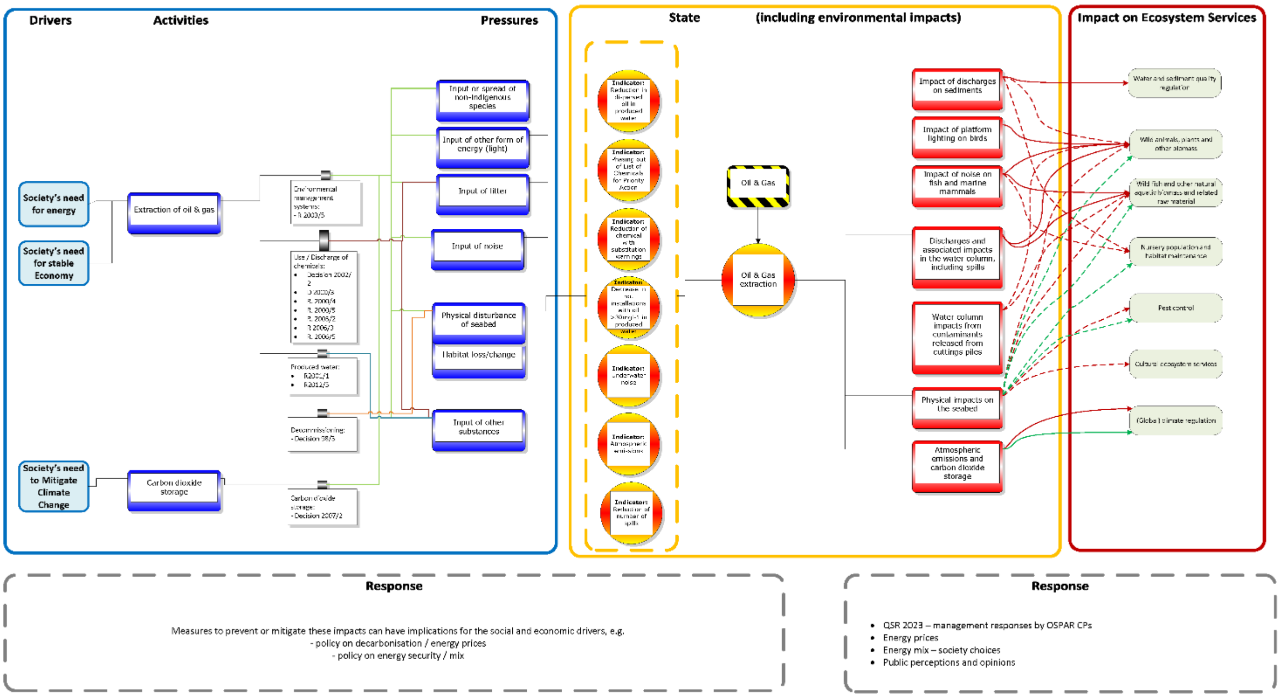
Continuous improvement remains a challenge, with hydrocarbon production at different stages in different regions and new developments continuing in Region I and II. In NEAES 2030 OSPAR has set out a number of Operational Objectives in relation to hazardous substances and marine litter (S2.O3, S2.O4, S4.O5 and S4.O6).

Good practice guidelines for geophysical surveys and use of explosives need to be developed This relates to NEAES Operational Objective S8.O1 and is relevant to the OSPAR regional action plan to reduce noise pollution.

On decommissioning, as older installations reach their end-of-life, it is anticipated that a number of installations will be decommissioned in the coming decade. While there has been progress in advancing certain technical capabilities, such as the increase in lift capabilities for removing topsides and steel jacket installations, no technology has been developed that would support a reduction in the categories eligible for derogation from OSPAR Decision 98/3. OSPAR has set out Operational Objectives in S9.O2 and S9.O3 in NEAES 2030.

There are only two full-scale projects on carbon dioxide storage in the OSPAR region. Due to this very limited number, an evaluation of the effectiveness of OSPAR Decision 2007/2 has not yet been undertaken. OSPAR has set out Operational Objectives in S12.O3 in NEAES 2030.

Bow-tie analysis



The bow-tie analysis for oil and gas activities shows the relationships between the DAPSIR components. Oil and gas activities and carbon capture and storage are identified as exerting pressures with the potential to cumulatively contribute to biodiversity state changes in the thematic assessments on Benthic Habitats; Fish; Marine Birds; Marine Mammals and Non-Indigenous Species. Collectively, the pressures from oil and gas activities on biodiversity status include:

Benthic habitats	Fish	Marine birds	Marine mammals
• Seabed disturbance • Habitat loss/change	• Noise	• Seabed disturbance • Habitat loss/change	• Seabed disturbance • Habitat loss/change

		• Disturbance of species • Input of other substances • Input of other forms of energy (light) • Input of litter	• Disturbance of species • Input of other substances • Input of other forms of energy (light) • Input of litter • Noise

The environmental pressures from oil and gas activities are described in the pressure section of this thematic assessment. Since a range of other human activities exert these same pressures, the biodiversity thematic assessments include consideration of the collective pressures from them.

Climate Change

Impact of emissions from offshore oil and gas exploration and exploitation and mitigation

OSPAR notes that oil and gas extracted from the OSPAR area is a substantial source of greenhouse gases contributing to global warming, climate change and Ocean Acidification. Assessment of the emissions to air associated with the end use of oil and gas extracted from the OSPAR area is, however, not within the remit of OSPAR. This Thematic Assessment focuses on emissions to air from offshore activities in the OSPAR area, which represents a small proportion of the total emissions arising from the use of oil and gas extracted within the area. In offshore activities, CO_2 accounts for the greatest proportion of emissions to air from offshore oil and gas installations. Approximately 29 Mt was emitted in the OSPAR Maritime Area in 2019.

Although atmospheric emissions are not covered by OSPAR measures or harmonised OSPAR measuring methodologies, they are regulated by EU measures or national regulations. Consistency in the quality of the reported offshore oil and gas production emissions data has undoubtedly improved over the past few years, particularly with regard to CO_2 emissions, which are independently verified as part of the EU ETS Directive. A decreasing trend in offshore oil and gas production emissions to the atmosphere was identified over the 2009-2019 period:

- CO_2 emissions decreased by 7,5% between 2009 and 2019, with decreases in most Contracting Parties except Norway;
- NO_x emissions trended downwards by 9,2% from 2009 to 2019, predominantly in Denmark, the Netherlands and Norway, where national measures to control NOx are in place. United Kingdom emissions remained largely static;
- Methane emissions decreased by 35% in 2009 to 2019 in most Contracting Parties, in particular Norway, the Netherlands and Germany;
- NMVOC emissions decreased by 7,2% in the 2009 to 2019 period, with significant decreases in most Contracting Parties offset by increases in the United Kingdom; and
- SO_2 emissions decreased by 33% between 2009 and 2019, with decreases in Denmark and the Netherlands offset by increases in Norway.

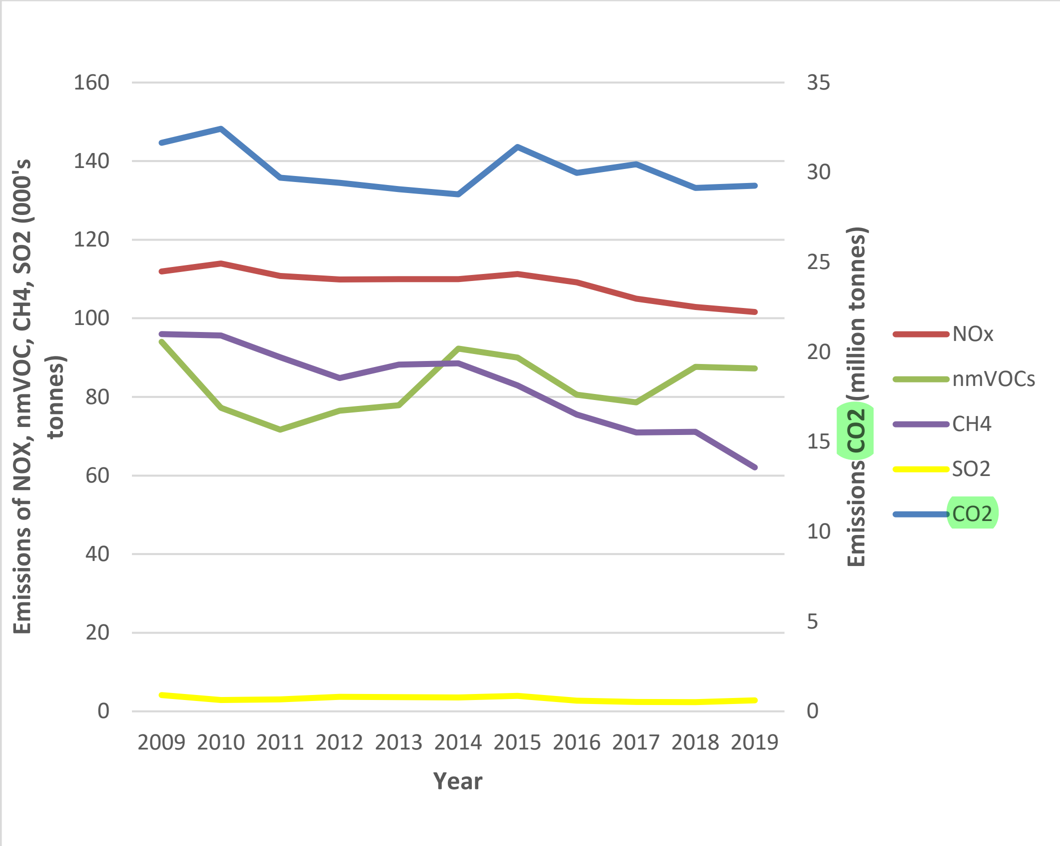


Figure CC.1: Emissions to air

The contribution to CO_2 emissions arising from the exploration and production activities of the offshore oil and gas industry as a proportion of Contracting Parties national emissions varies depending on the size of the oil and gas industry in the Contracting Party[1]. For Contracting Parties with a small offshore industry footprint such as Spain, Germany, and Ireland the contribution from oil and gas ranges from 0,001 – 0,2% of total national emissions. For Denmark and the Netherlands, it is an average of 4,9% and 1,1% respectively, while in Norway and the United Kingdom it is 35,5%[2] and 3,4% respectively.

Measures taken by operators to improve combustion plant efficiency and reduce fugitive emissions (e.g., methane leaks) have contributed towards emissions reduction. However, in interpreting these changes, one must take into account factors which have a direct influence on atmospheric emissions, such as the fact that emissions associated with mature fields would increase due to the greater power demands associated with the use of injection as a method to dispose of produced water and drill cuttings, and the possible use of diesel generation for such activities where there are native fuel gas supply deficits. The decommissioning of ageing installations in the coming years may generate emissions similar to those of production installations. However, following these temporary activities longer-term operational emissions would cease at these locations.

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[1] National CO_2 emission data taken from iea.org

[2] The relative contribution from the oil and gas industry to Norwegian emissions is high compared to the other OSPAR countries. This is due to oil and gas being the largest industry in Norway and that hydropower is the major source of energy for other industries and households.

The future – The World Bank's 'Zero Routine Flaring by 2030' initiative invites governments and industry to end the operational practice of routine flaring during normal production operations by 2030. Denmark, Germany, the Netherlands, Norway, and the United Kingdom have committed to this initiative. Similarly, as the largest proportion of emissions from offshore oil and production stem from power generation, efforts to connect offshore installations to the main grid or renewable power sources are gaining momentum and are expected to further reduce emissions from offshore installations in the next decade.

Risks and consequences from climate change for the offshore industry

Current knowledge indicates that pressures and impacts related to climate change and ocean acidification will intensify markedly. In the North Sea, the water temperature has risen as a result of climate change and changes in ocean circulation, and acidification has been registered. In the Arctic waters, climate change has resulted in long-term trends of rising sea temperatures, shrinking ice coverage and large-scale ecological changes, especially in the northernmost areas.

Some of these climate factors can be expected to affect the offshore oil and gas industry. Reduced ice coverage may result in increased activity in the Arctic due to increased access to Arctic resources as sea ice retreats following the rise in global temperature.

Climate change also presents a changing hazard to offshore infrastructures in the long term. Meteorological and oceanographic conditions that present a risk to offshore infrastructure from climate change include extreme wind, waves, current events, and rising sea level.

The vulnerabilities resulting from extreme storms and high wave events include the destabilisation or degradation of offshore structures, risk to offshore workers, reduced operating periods, damage to pipeline systems due to sediment transport and the prevention of access for maintenance and inspection activities, thereby increasing the likelihood of accidents including pollution incidents.

While design codes for offshore infrastructure have been in place for some time, these are having to evolve to allow for the future effects of climate change on the selection of environmental loads, air gaps beneath structures, and for the effects of other actions on offshore infrastructure.

While shifts in policies towards low carbon economies gain momentum, it is recognised that oil and gas will remain part of the energy mix (albeit declining) for many countries. The risks of unabated emissions from offshore oil and gas production remain in the context of climate change.

Thematic Metadata

Field	Explanation
Linkage	DNV, 2008. Drill cuttings on the NCS. Data compilation. DNV, 2017. Drill cuttings piles management and environmental experiences, https://www.norskoljeoggass.no/contentassets/d7c4e49a4a1443d89def8dec143c4c43/drill-cuttings-piles-management-and-environmental-experiences--dnv-gl-report-19-12-2017.pdf E. van der Zee, L.W Bruinzel Systematic data collection on the effecs of platform illumination on migratory birds. A&W rapport nr 1987, Altenburg & Wynmenga ecologish onderzoek, Feanwâlden 2014 (OIC 14/10/2) Genesis, 2016. Inventory of measures and techniques to mitigate the impact of seismic surveys. December 2015. Presented at OIC 2016 (OIC 16/08/04) Genesis, 2019. Impacts of decommissioned pipelines on the marine environment and on other users of the sea. January 2019. Presented at OIC 2019 (OIC 19/09/02) IOGP. The E&P Sound & Marine Life Joint Industry Programme. https://www.soundandmarinelife.org/ OSPAR Workshop on research into possible effects of offshore platform lighting, January 2012
Relevant OSPAR Documentatio n	OSPAR Agreement 2005-15 OSPAR Reference Method of Analysis for the Determination of the Dispersed Oil Content in Produced Water (amended in 2011). OSPAR Publication 2007-337 Assessment of the possible effects of releases of oil and chemicals from any disturbance of cuttings piles (updated 2009) OSPAR Publication 2009-453 Assessment of impacts of offshore oil and gas activities in the North-East Atlantic Quality Status Report 2010 OSPAR Publication 2012-568 Report of the OSPAR Workshop on research into possible effects of regular platform lighting on specific bird populations OSPAR Publication 2013-602 Background Document concerning Techniques for the Management of Produced Water from Offshore Installations OSPAR Agreement 2015-08 Guidelines to reduce the impact of offshore installations lighting on birds in the OSPAR maritime area OSPAR Publication 2016-684 Impacts of certain pressures of the offshore oil and gas industry on the marine environment – stocktaking report OSPAR Agreement 2017-03 Guidelines for the Sampling and Analysis of Cuttings Piles OSPAR Publication 2017-705 Assessment document of land-based inputs of microplastics in the marine environment

	OSPAR Publication number 2020-767 Annual report and assessment of discharges of radionuclides from the non-nuclear sectors in 2018 OSPAR Publication number 2019-745 Report and assessment of the disturbance of drill cuttings during decommissioning OSPAR, 2019. Report on the Special Consultative Meeting according to OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations, The United Kingdom's intention to issue a permit under Paragraph 3(a) and 3(b) of OSPAR Decision 98/3 for leaving in-situ the footings of the Brent Alpha steel jacket and each of the gravity based concrete installations of Brent Bravo, Brent Charlie and Brent Delta OSPAR 2019, Informal meeting to discuss Comparative Evaluation of Decommissioning Options in support of Derogation Proposals OSPAR Publication 2021-803 Assessment of the OSPAR Report on Discharges, Spills and Emissions from Offshore Installations, 2009 – 2019 OSPAR Publication 2021-804 Report on impacts of discharges of oil and chemicals in produced water on the marine environment OSPAR, 2021. OSPAR Inventory of Offshore Installation – 2019 OSPAR Agreement 2007-12 Guidelines for Risk Assessment and Management of Storage of CO_2 Streams in Geological Formations

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OSPAR Secretariat
The Aspect
12 Finsbury Square
London
EC2A 1AS
United Kingdom

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

Our vision is a clean, healthy and biologically diverse North-East Atlantic Ocean, which is productive, used sustainably and resilient to climate change and ocean acidification.

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