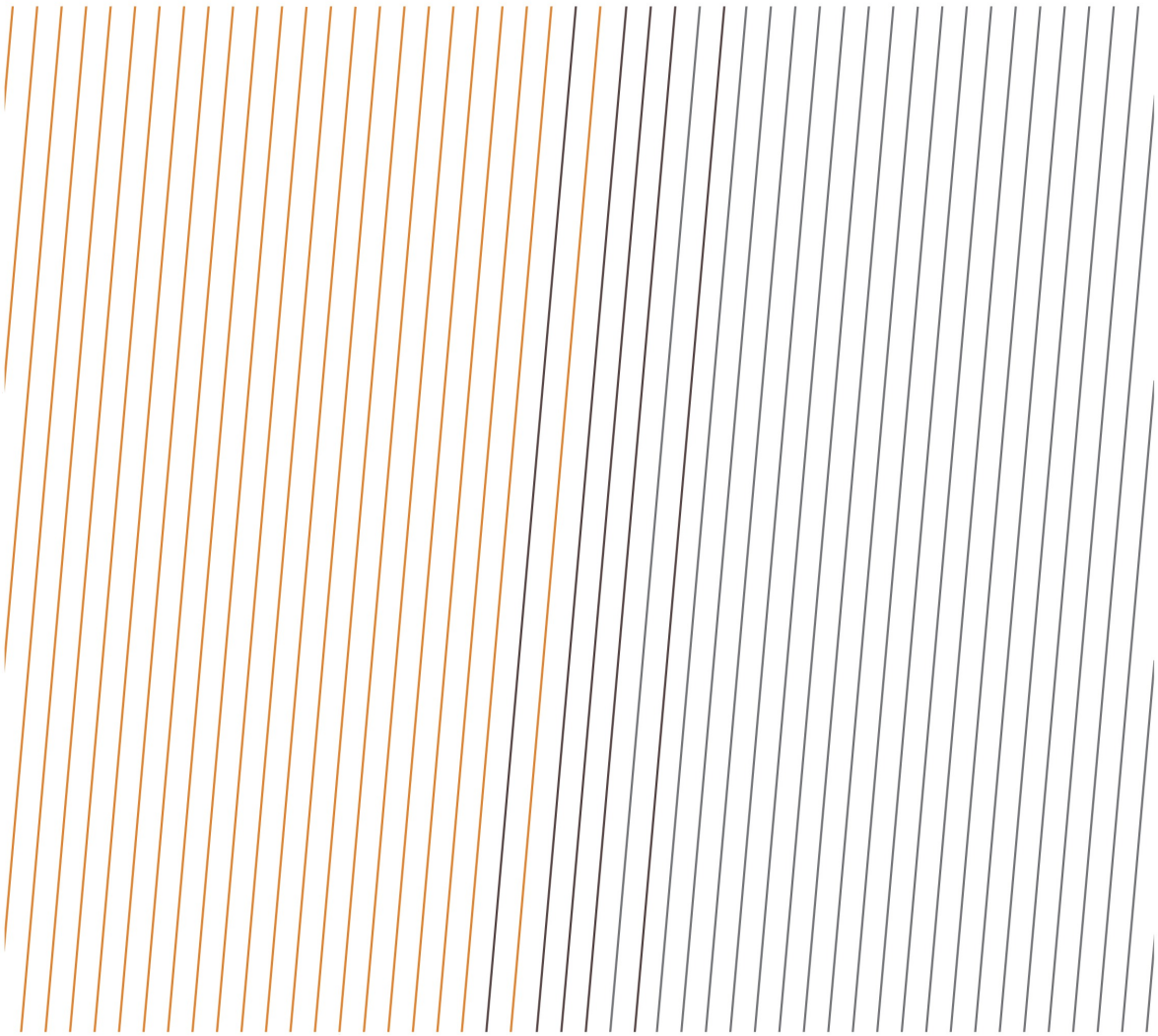
International Association of Oil & Gas Producers

REPORT
2018e

February
2022

DATA SERIES

IOGP Environmental performance indicators - 2018 data



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Revision history

VERSION	DATE	AMENDMENTS
1.0	September 2020	First release
2.0	February 2022	Corrected the total cubic meters of freshwater withdrawn for use specified in Section 7, paragraph 3

Contents

Contributing companies

The environmental statistics were derived from data provided by the following companies:

2020

ADNOC
Aker BP
Assala Energy
BHP
BP
Capricorn Energy PLC.
CEPSA EP
Chevron
Chrysaor
CNOOC
ConocoPhillips
Dolphin Energy
ENI
Equinor ASA
ExxonMobil
GENEL
Husky Energy
INPEX Corporation
KMG
Kosmos Energy
Kuwait Oil Company
MOL
Neptune Energy
North Oil Company
Oil Search
OMV
Pan American Energy
Petrobras
PGNiG
Pluspetrol
Premier Oil
PTTEP
Shell Companies
SOCAR
Sonangol
Suncor
TotalEnergies
Tullow Oil
Vår Energy
Wintershall Dea
Woodside

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Equinor ASA
ExxonMobil
GENEL
Gulf Keystone
Hess Corporation
Husky Energy
INPEX Corporation
KMG
Kosmos Energy
Kuwait Oil Company
MOL
Neptune Energy
North Oil Company
Oil Search
OMV
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2018

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ExxonMobil
GeoPark
Gulf Keystone
Hess Corporation
Husky Energy
INPEX Corporation
KMG
Kosmos Energy
Kuwait Oil Company
MOL
Neptune Energy
Nexen Inc
North Oil Company
Oil Search
OMV
Pan American Energy
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Introduction

The International Association of Oil and Gas Producers (IOGP) has collected and published environmental data from its Member Companies every year since 2001. The ultimate aim of this effort is to provide a representative statement on the environmental performance of the contributing IOGP Member Companies.

Subsidiary objectives are to provide a basis for individual Member Companies to compare their environmental performance, thereby helping them to identify areas for improvement and to demonstrate the industry's wish for greater transparency concerning its activities.

Environmental information is collected under the following categories:

- gaseous emissions
- energy consumption
- flaring
- produced water discharges
- non-aqueous drilling fluids retained on cuttings discharged to sea
- oil and chemical spills
- fresh water withdrawn for use

Data are collected annually for each of the categories above, on the basis of a set of definitions agreed by the IOGP Membership. These definitions align with IPIECA/API/IOGP Report 437 - *Oil and gas industry guidance on voluntary sustainability reporting*. The definitions are provided via a user guide that is reviewed at regular intervals and updated to reflect improvements in reporting and to provide additional clarification.

Scope of data submissions

The 43 IOGP participating Member Companies reported 2018 environmental data for, on average, 13 countries each. Information reported for 2018 covered operations in a total of 73 countries.

To show the data from a geographical perspective, 7 regions have been defined, as shown in Figures 1 and 2.

Figure 1:

Regional contribution to total production reported by participating companies (2018)

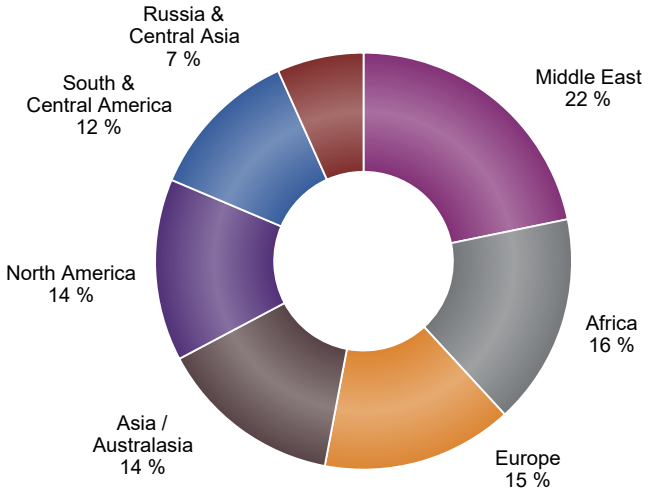
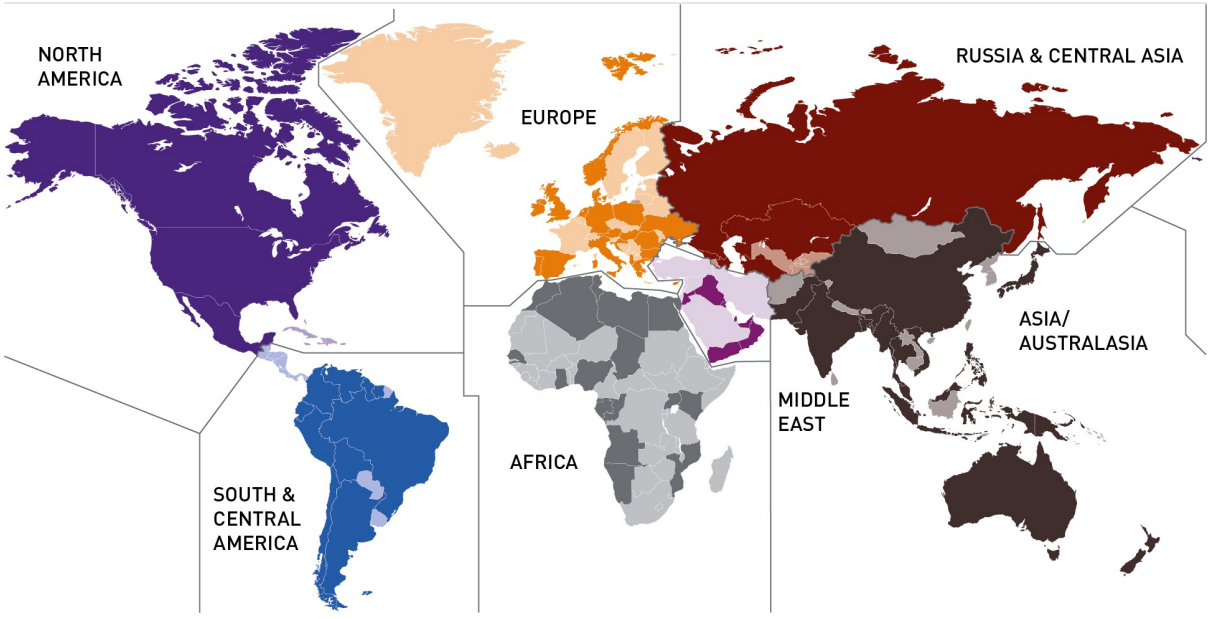


Figure 2. Data provided for the 7 geographic regions (2018)



This report only reflects the performance of the IOGP Member Companies that have provided data in a given year. For 2018, the data represent 2,131 million tonnes of hydrocarbon production, equivalent to approximately 27% of 2018 world production as reported in the BP Statistical Review of World Energy 2019.

There is substantial variation in regional coverage when compared with the 2018 sales production reported in the BP Statistical Review of World Energy 2019, as shown in Figure 3.

- In Europe, where a high percentage (83% in 2018) of hydrocarbon production is represented, the information can be taken to approximate 'industry' performance in that region.
- In Africa (59%), South & Central America (52%) and Asia/Australasia (34%), the data give a broad indication of industry performance.
- For the Middle East (22%) and North America (16%), the regional coverage is less comprehensive, giving a weaker indication of industry performance.
- For the Russia & Central Asia region, data reported by participating companies represent just 10% of the total sales production for that region and thus may not be representative of the region's performance.

Figure 3:

Production reported by participating companies relative to sales production in BP Statistical Review of World Energy by region (2018)

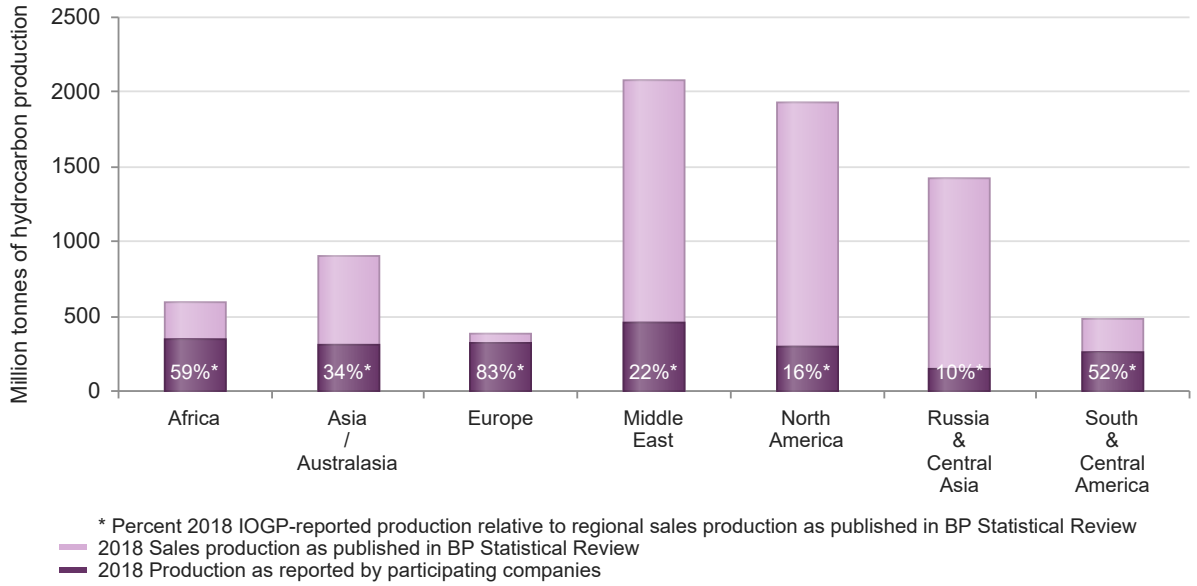
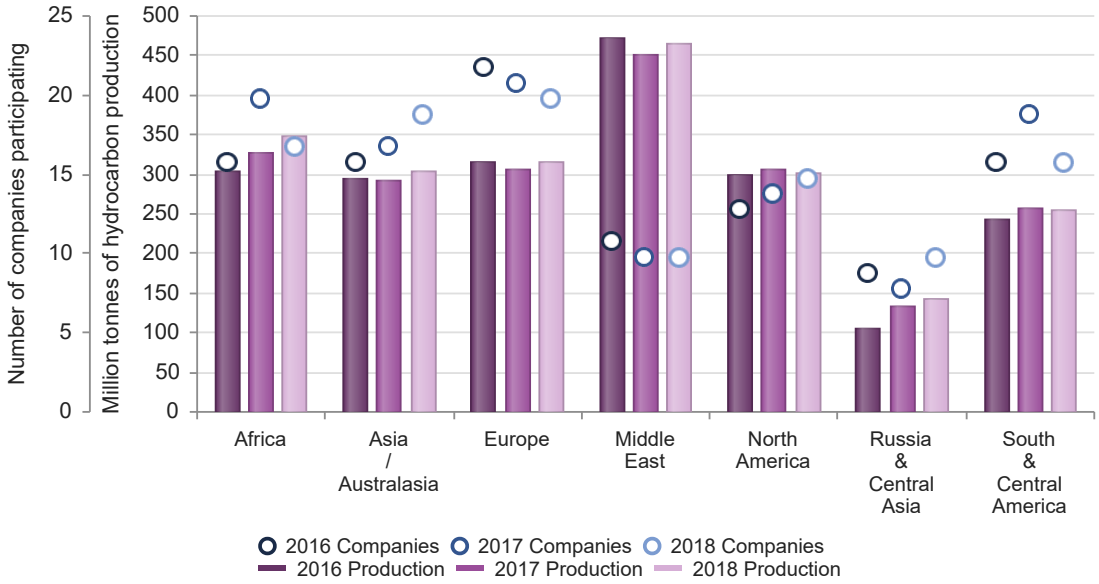


Figure 4:

Hydrocarbon production reported by participating companies and the number of participating companies (2016–2018)



Changes in results for various environmental indicators may not necessarily reflect actual changes in performance for the following reasons:

- The number and makeup of companies reporting has fluctuated between years, as shown in Table 1 and Figure 4.
- Not all metrics are consistently reported each year by all companies, (reporting coverage by metric for 2018 is shown in Table 2).
- Performance indicator results may be influenced by changes in mixtures of assets held by the participating companies between years.
- Differences between years for participating companies may also, in some cases, reflect changes in calculation methodology applied or reporting definitions.

Table 1. Company participation

Year	Companies Reporting	Companies Joining (did not report previous year)	Companies dropping out (reported previous year)
2020	41	2	3
2019	42	4	5
2018	43	4	5
2017	44	9	1
2016	36	1	3

Note: This represents the number of companies reporting hydrocarbon production. Some companies that reported hydrocarbon production did not report data for all metrics, e.g. atmospheric emission or produced water discharges, consistently for all countries each year.

Data in the figures are generally presented on a normalized basis. This allows relative comparisons across regions and reduces the effect of variations in reporting coverage. normalized analyses are only possible when data are available for both the metric to be normalized (e.g., emissions, discharges, spills) and the normalizer (e.g., hydrocarbon production, produced water).

Some of the analyses cover less than 100% of the total production reported because some companies did

not submit data for all metrics covered in the survey, as shown in Table 2A. IOGP Member Companies that do not participate are generally those whose reporting processes are not yet fully aligned with IOGP requirements.

The current year data shown in this report are based on the best available information that Member Companies are able to provide at time of publication.

Table 2A: Percentage of reported production included in normalized analyses by region 2018

Region	Gas emissions					Energy consumed	Flaring	Oil discharged in produced water	Oil spills	Fresh water withdrawal
	CH4	NMVOC	SO2	NOX	CO2					
Africa	100	97	97	97	100	100	100	98	100	87
Asia / Australasia	100	99	100	100	100	100	100	99	100	77
Europe	100	100	100	100	100	100	100	98	97	96
Middle East	100	96	100	100	100	100	100	95	100	99
North America	100	99	100	100	100	88	100	88	100	84
Russia & Central Asia	100	85	100	100	100	100	100	92	93	72
South & Central America	100	93	100	100	100	100	100	100	100	100
ALL REGIONS	100	97	100	100	100	98	100	96	99	89

Green: (90%–100%): data fairly representative of participating companies in the region

Yellow: (65%–89%) data moderately representative

Orange: (30%–64%): lower confidence that data are representative

Red: (0%–29%): lowest confidence that data are representative

Data on the source types of gaseous emissions (energy, flare, vent, fugitive emissions, and other) have been collected since 2009. It is recognized that not all participating companies are able to contribute data at that level of detail; nevertheless, data broken down by source cover the majority (between 52% and 79%) of the gaseous emissions reported for 2018 for the emissions compounds discussed in this report.

Table 2B: Percentage of total reported emissions where information on source was not specified 2016 - 2018

Year	Percentage of gas emissions categorized as 'Other/Unspecified' source				
	CH4	NMVOC	SO2	NOX	CO2
2018	21	27	48	38	35
2019	24	26	47	37	35
2020	2	15	46	22	6

Green: (0%–29%), Yellow: (30%–64%), Orange: (65%–89%), Red:(90%–100%)

Detailed review

1. Gaseous emissions

Gaseous emissions covered in this report are those considered most relevant to the nature of E&P activities as well as regulatory perspectives*:

- CO_2: carbon dioxide
- CH_4: methane
- GHG: greenhouse gas is CO_2 + CH_4 expressed as CO_2 equivalent
- NMVOCs: Non-Methane Volatile Organic Compounds are all hydrocarbons, other than methane
- SO_2: the sum of sulphur dioxide (SO_2) and sulphur trioxide (SO_3) expressed as SO_2 equivalent
- NO_X: the sum of nitric oxide (NO) and nitrogen dioxide (NO_2) expressed as NO_2 equivalent. Nitrous oxide (N_2O) is not included as a component of NO_X.

As nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride contribute only a small fraction of greenhouse gas emissions from E&P activities, they have not been included here.

Given the wide range of sources of gaseous emissions, it is not practicable (or possible) to measure every single source. Industry has, however, developed and updated detailed guidance methodologies to calculate and estimate emissions and losses**. Since companies may use a variety of estimation techniques care must be taken when interpreting aggregated data.

A number of factors affect the quantity of gases emitted from E&P petroleum industry operations. Consequently, understanding the variations in performance in terms of normalized emission ratios is complex.

These factors include:

- presence or absence of infrastructure for gas sales
- gas–oil ratio
- reservoir and field characteristics
- production techniques
- regulatory and contractual aspects
- location and logistics
- age of the fields
- emissions controls

Normalized figures for 2014–2018 direct emissions are shown in Figures 5 and 6. Emissions reported are those directly emitted by the facilities operated or controlled by the participating companies. Emissions from the generation of energy (electricity, steam) purchased from third parties are not reported.

*** Consistent with IPIECA/API/IOGP Oil and gas industry guidance on voluntary sustainability reporting, 2015*

** See for example:*

- *Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions (2003) Joint IPIECA/API/IOGP report (in revision);*
- *Compendium of Greenhouse Gas Emission Estimation Methodologies for the Oil and Gas Industry, API, 2009;*
- *SangeaTM Energy and Emissions Estimating System, API, http://GHG.API.org.*

Figure 5:

Atmospheric emissions per thousand tonnes hydrocarbon production
(2014–2018)

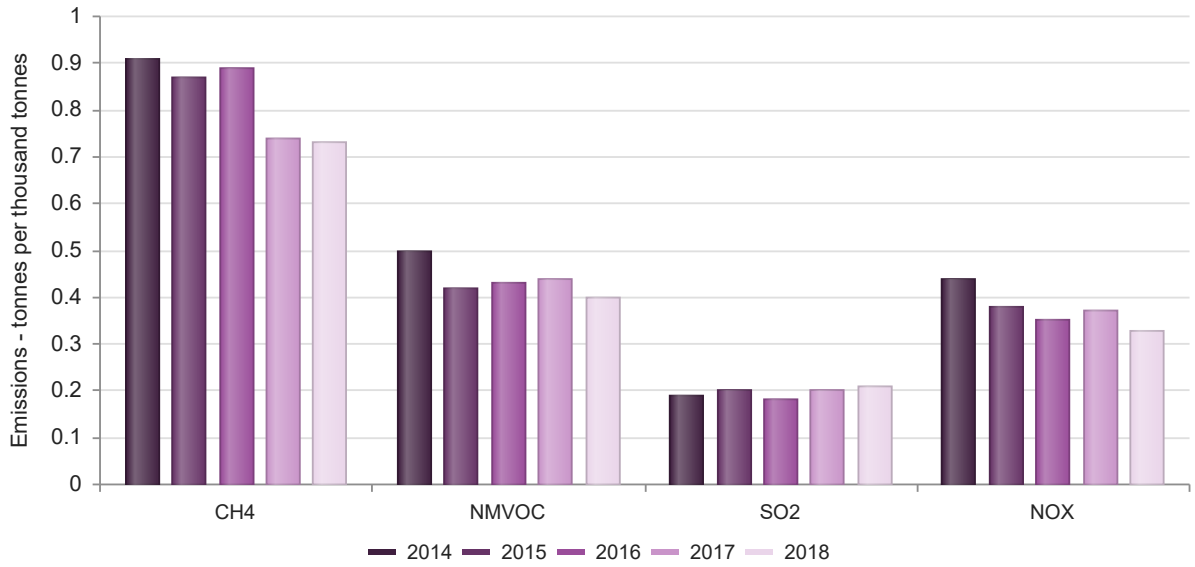
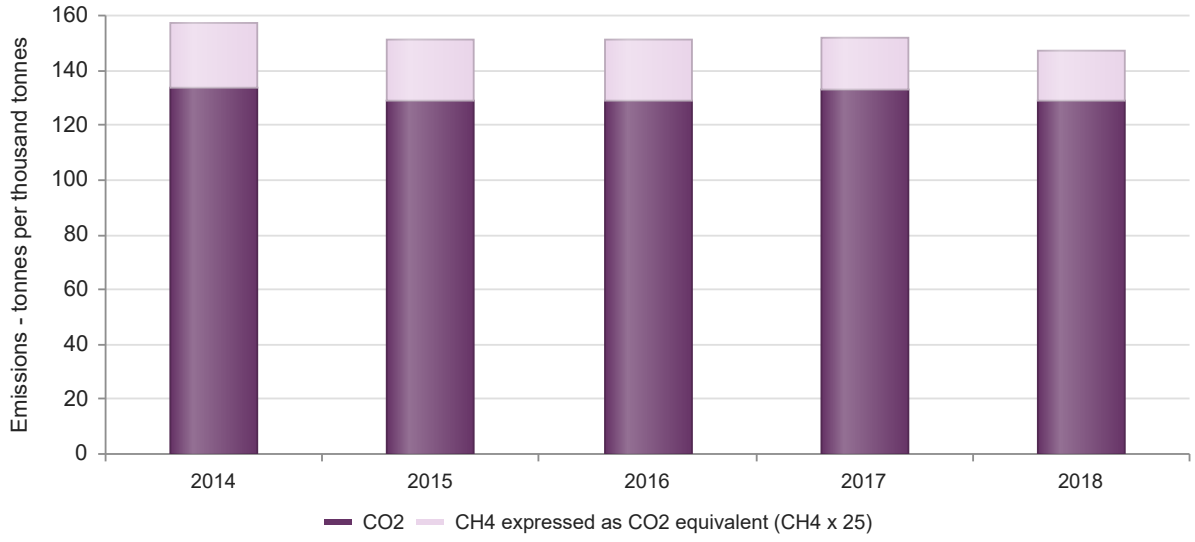


Figure 6:

CO2 and CH4 expressed as CO2 equivalent
per thousand tonnes hydrocarbon production
(2014–2018)



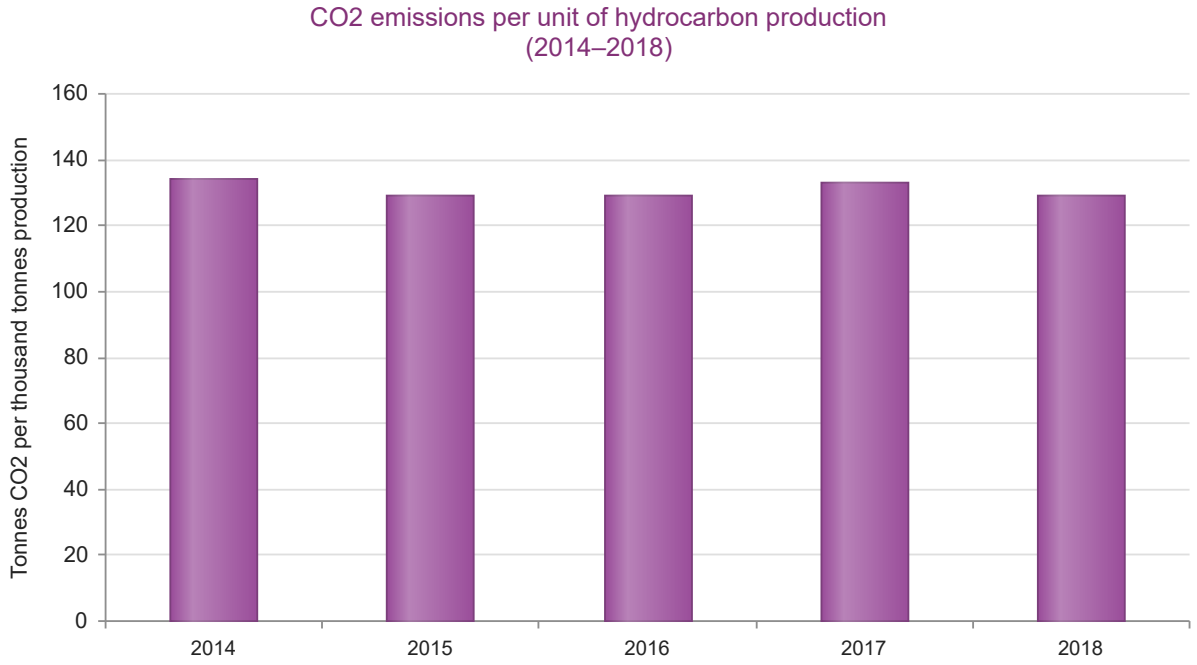
1.1 Carbon dioxide (CO_2)

Emissions of carbon dioxide occur principally from the combustion of fuels for energy production and from flaring. Carbon dioxide releases may also occur where CO_2 is stripped from the reservoir gases to meet sales specifications.

Emissions per unit of production

Overall, CO_2 emissions normalized to hydrocarbon production for 2018 participating companies were 129 tonnes of CO_2 per thousand tonnes of production, 3% lower than the average result for the 2017 participating companies, as shown in Figure 7.

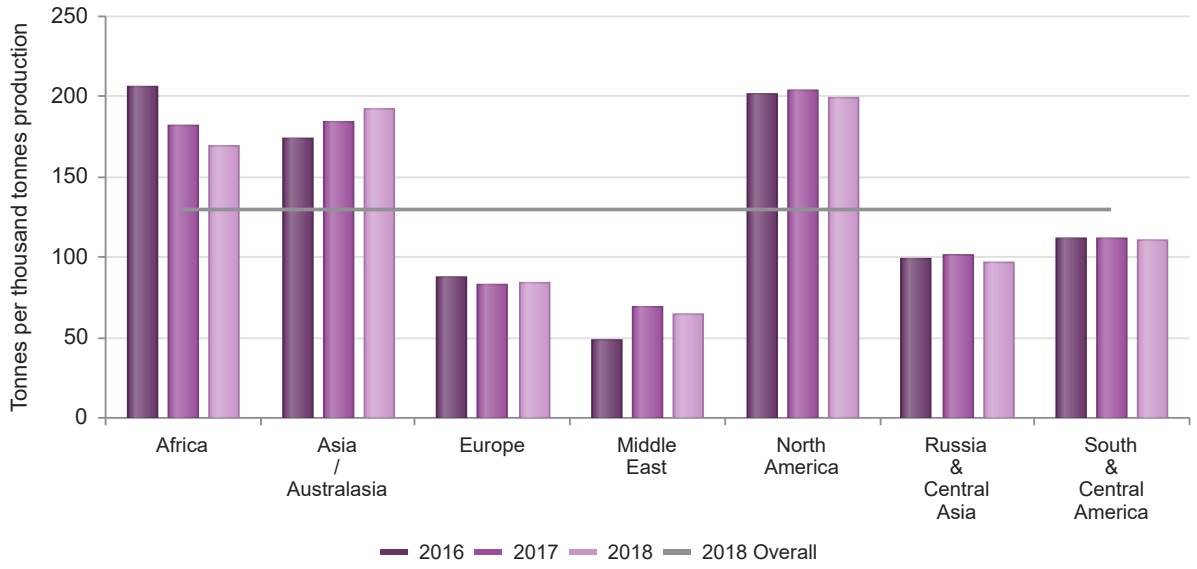
Figure 7:



In 2018, regional averages for carbon dioxide emissions expressed per unit of production varied from 64 to 199 tonnes of carbon dioxide per thousand tonnes of hydrocarbon production, as shown in Figure 8. In 2017, the range was between 69 and 204 tonnes per thousand tonnes of production. The wide range across regions points towards the strong influence of different types of production assets on greenhouse gas metrics.

Figure 8:

CO2 emissions per unit of hydrocarbon production by region (2016–2018)

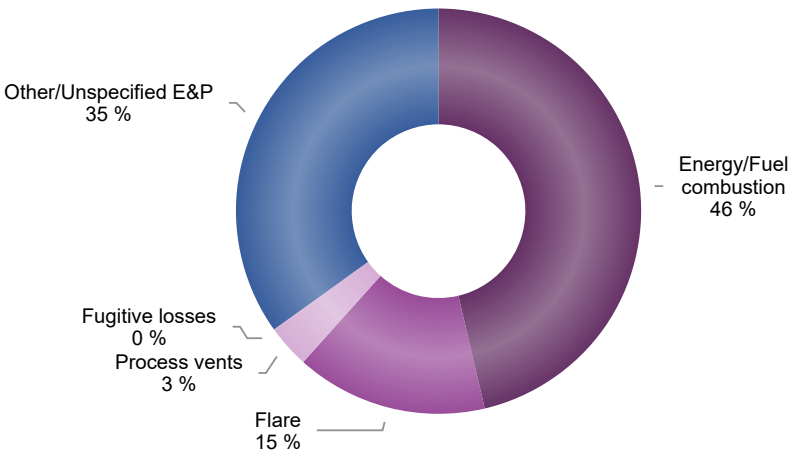


Emissions by source

The source was specified for 65% of the carbon dioxide emissions reported for 2018. 46% of the reported carbon dioxide emissions were from energy use, 15% were from flaring, 3% were from venting or vents (including venting, vessel loading, tank storage, pneumatic devices, etc.), and 0.02% were from fugitive losses, as shown in Figure 9.

Figure 9:

CO2 emissions by source (2018)



1.2 Methane (CH_4)

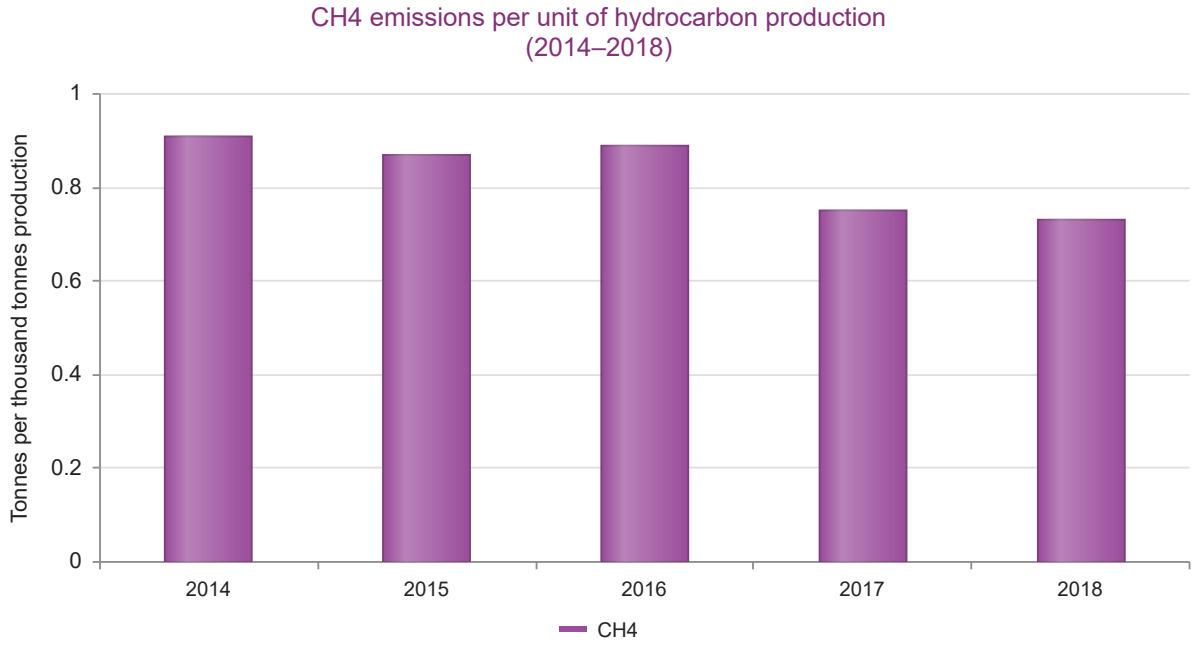
Methane is emitted from sources including process vents, gas-driven pneumatic devices, and tank vents. It also escapes as fugitive emissions from process components (valves, flanges, etc.). In addition, some methane emissions result from incomplete combustion of hydrocarbons in flares.

Emissions per unit of production

Overall, CH_4 emissions normalized to hydrocarbon production for 2018 participating companies were 0.73 tonnes of CH_4 per thousand tonnes of production, 1% lower than the average result for the 2017 participating companies, as shown in Figure 10.

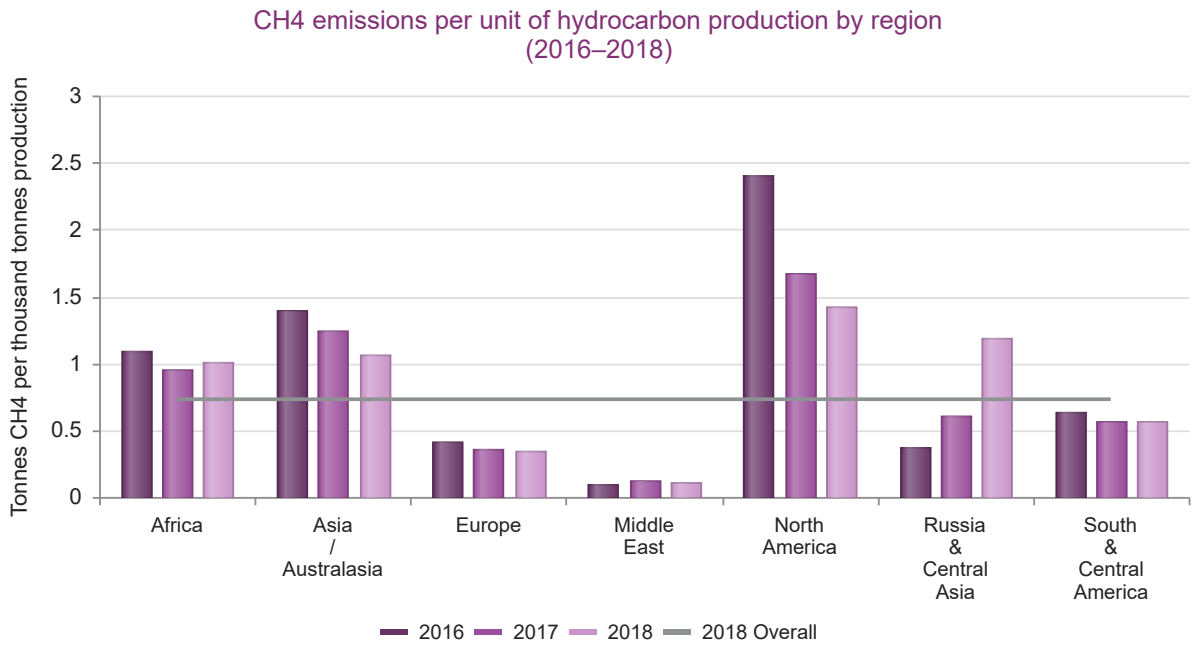
The increase in methane emissions in Russia & Central Asia is due to the introduction of new data.

Figure 10:



In 2018, regional averages for methane emissions expressed per unit of production varied from 0.1 to 1.4 tonnes of methane per thousand tonnes of hydrocarbon production, as shown in Figure 11. In 2017, the range was between 0.1 and 1.7 tonnes per thousand tonnes of production. The wide range across regions points towards the strong influence of different types of production assets on greenhouse gas metrics.

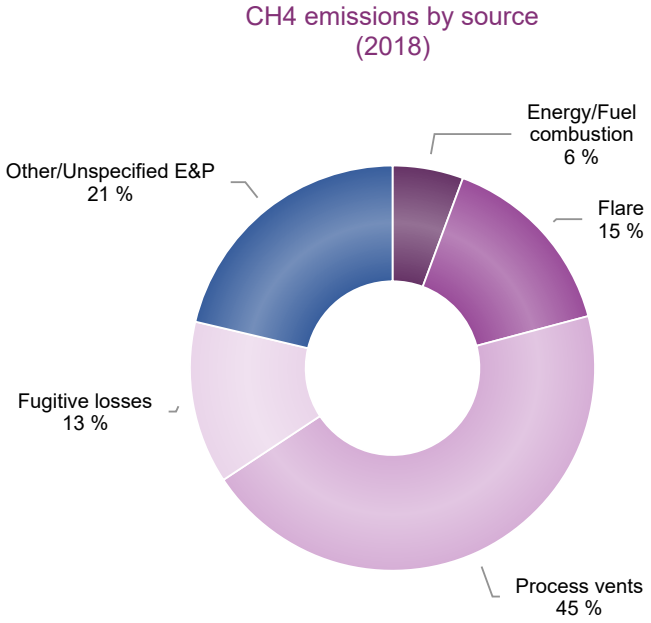
Figure 11:



Emissions by source

The source was specified for 79% of the methane emissions reported for 2018. 45% of the reported methane emissions were from venting or vents (including venting, vessel loading, tank storage, pneumatic devices, etc.), 13% were from fugitive losses, 15% were from flaring, and 6% were from energy use, as shown in Figure 12.

Figure 12:



1.3 Greenhouse gas (GHG*)

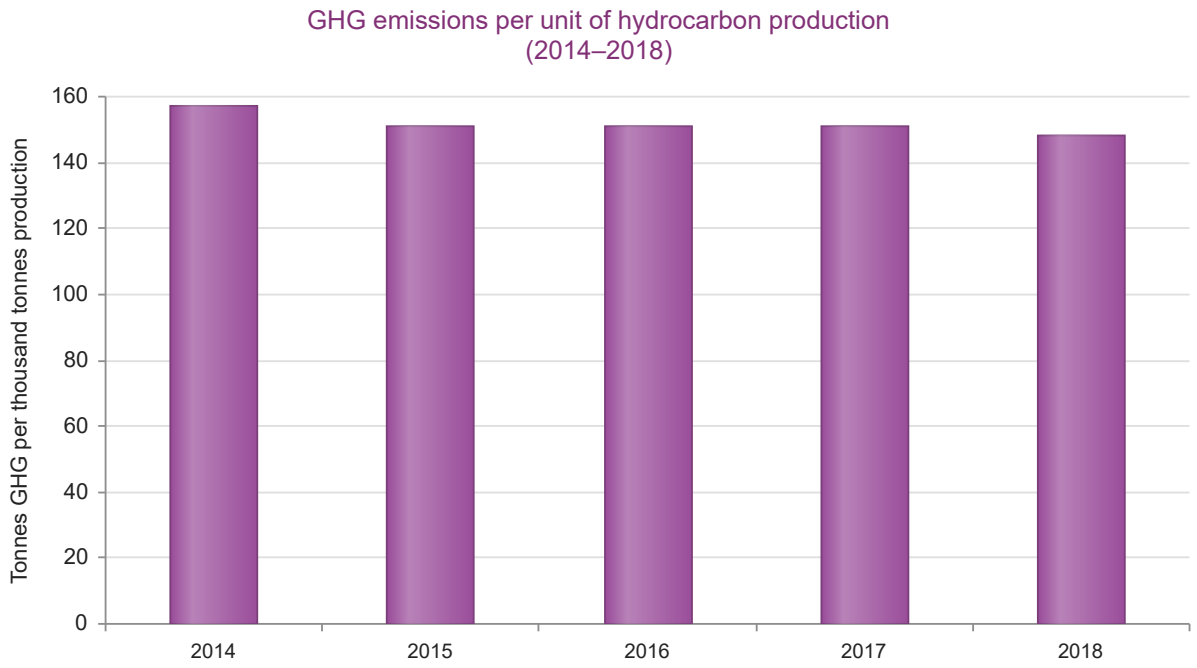
For E&P activities, CO_2 and CH_4 are the principal contributors to greenhouse gas emissions.

The CO_2 and CH_4 data presented above are used to calculate an estimate of the GHG emissions for the contributing IOGP reporting companies, using the conversion to CO_2 equivalent (GHG = CO_2 + 25 x CH_4)**.

Emissions per unit of production

Participating companies in 2018 reported normalized emissions of 148 tonnes of GHG per thousand tonnes of hydrocarbon production, 2% lower than the average result for the 2017 participating companies, as shown in Figure 13.

Figure 13:

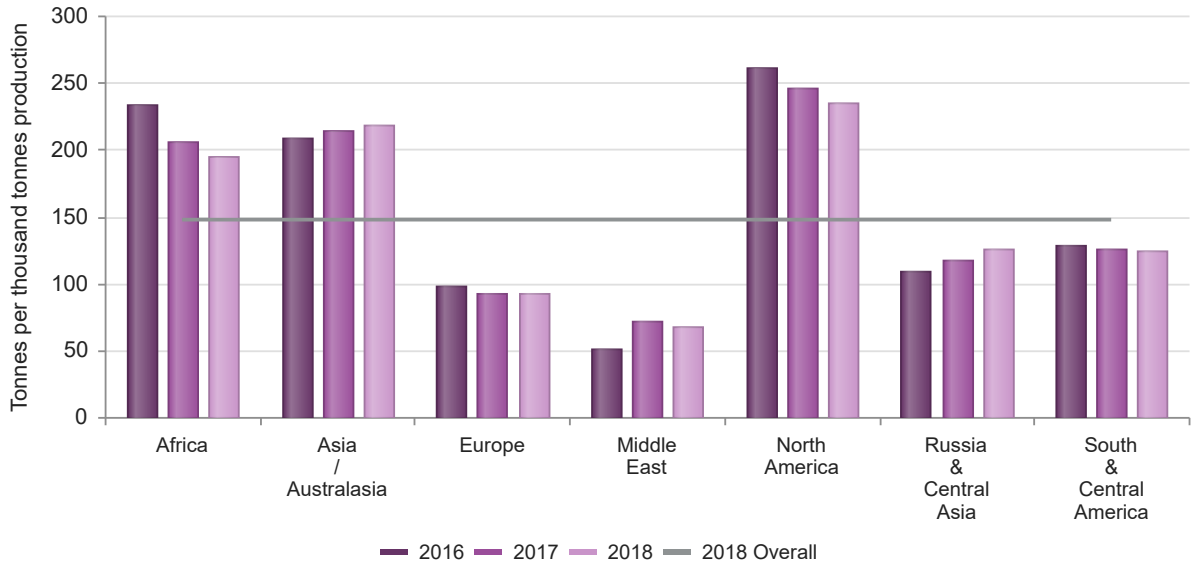


** GHG: Total Greenhouse Gases (CO2 + CH4 expressed as CO2 equivalent)*
*** Consistent with IOGP-IPIECA-API Report 437 - Sustainability reporting guidance for the oil and gas industry (4th ed., 2020)*

In 2018, regional averages for quantity of greenhouse gas emissions expressed per unit of production varied from 67 to 235 tonnes of greenhouse gas per thousand tonnes of hydrocarbon production, as shown in Figure 14. In 2017, the range was between 72 and 246 tonnes per thousand tonnes of production. The wide range across regions points towards the strong influence of different types of production assets on greenhouse gas metrics.

Figure 14:

GHG emissions per unit of hydrocarbon production by region (2016–2018)

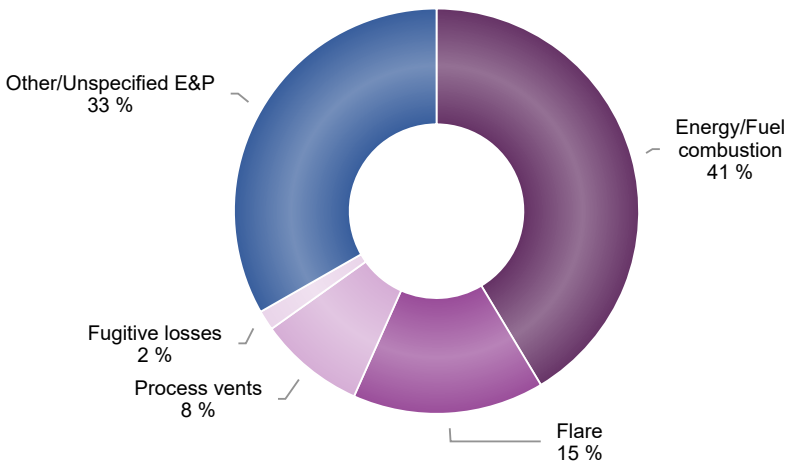


Emissions by source

The source was specified for 67% of the greenhouse gas emissions reported for 2018. 41% of the reported greenhouse gas emissions were from energy use, 15% were from flaring, 8% were from venting or vents (including venting, vessel loading, tank storage, pneumatic devices, etc.), and 2% were from fugitive losses, as shown in Figure 15.

Figure 15:

GHG emissions by source (2018)



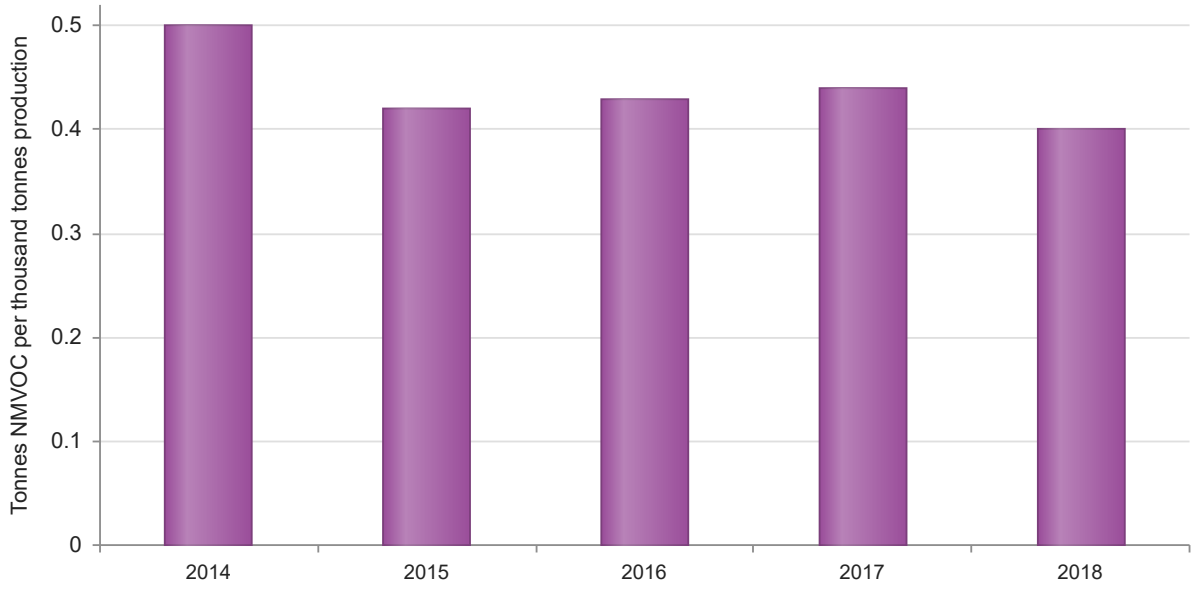
1.4 Non-methane volatile organic compounds (NMVOCs)

NMVOC emissions mainly occur from flaring, venting and fugitive releases and, to a lesser extent, combustion equipment.

Overall NMVOC emissions normalized to hydrocarbon production for 2018 participating companies were 0.40 tonnes of NMVOC per thousand tonnes of production, 9% lower than the average result for the 2017 participating companies, as shown in Figure 16.

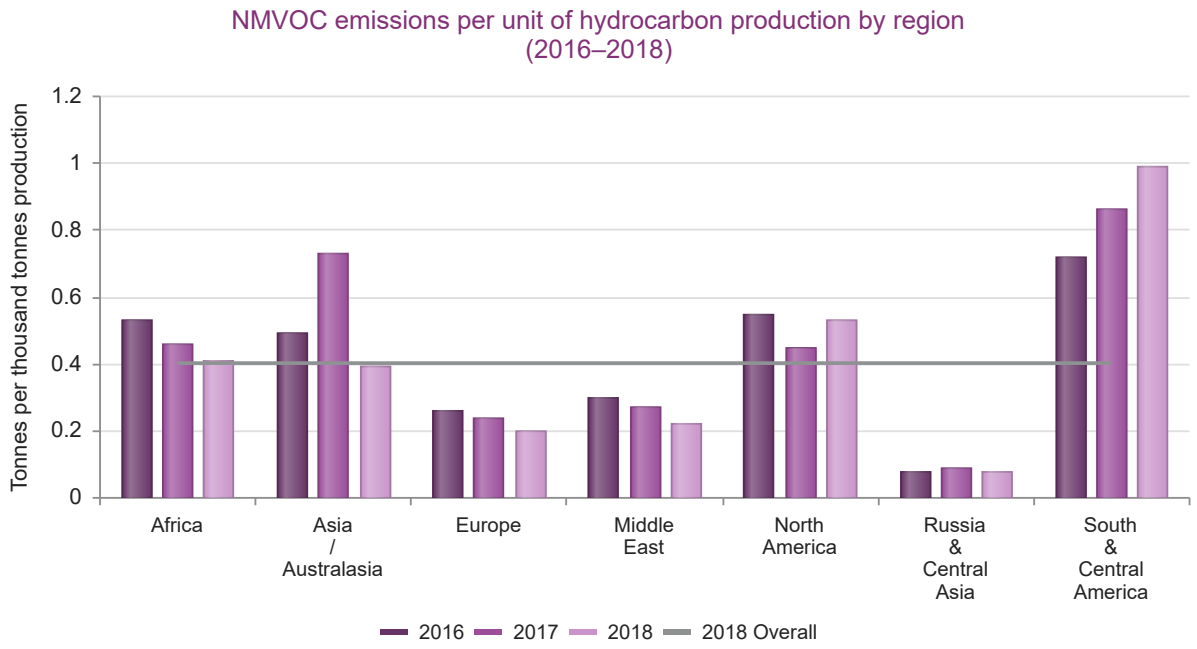
Figure 16:

NMVOC emissions per unit of hydrocarbon production (2014–2018)



In 2018, regional averages for NMVOC emissions expressed per unit of production varied from 0.1 to 1.0 tonne of NMVOC per thousand tonnes of hydrocarbon production, as shown in Figure 17. In 2017, the range was between 0.1 and 0.9 tonnes per thousand tonnes of production.

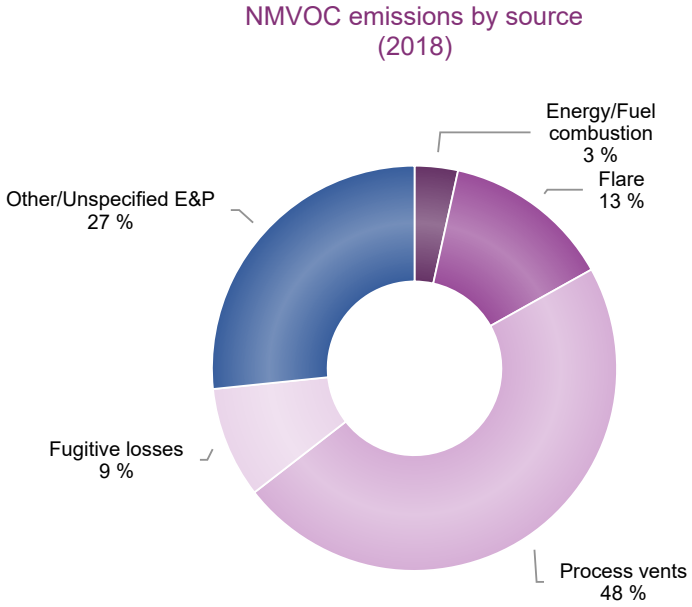
Figure 17:



Emissions by source

The source was specified for 73% of the NMVOC emissions reported for 2018. 48% of the reported NMVOC emissions were from venting or vents (including venting, vessel loading, tank storage, pneumatic devices, etc.), 13% were from flaring, 9% were from fugitive losses and 3% were from energy use, as shown in Figure 18.

Figure 18:

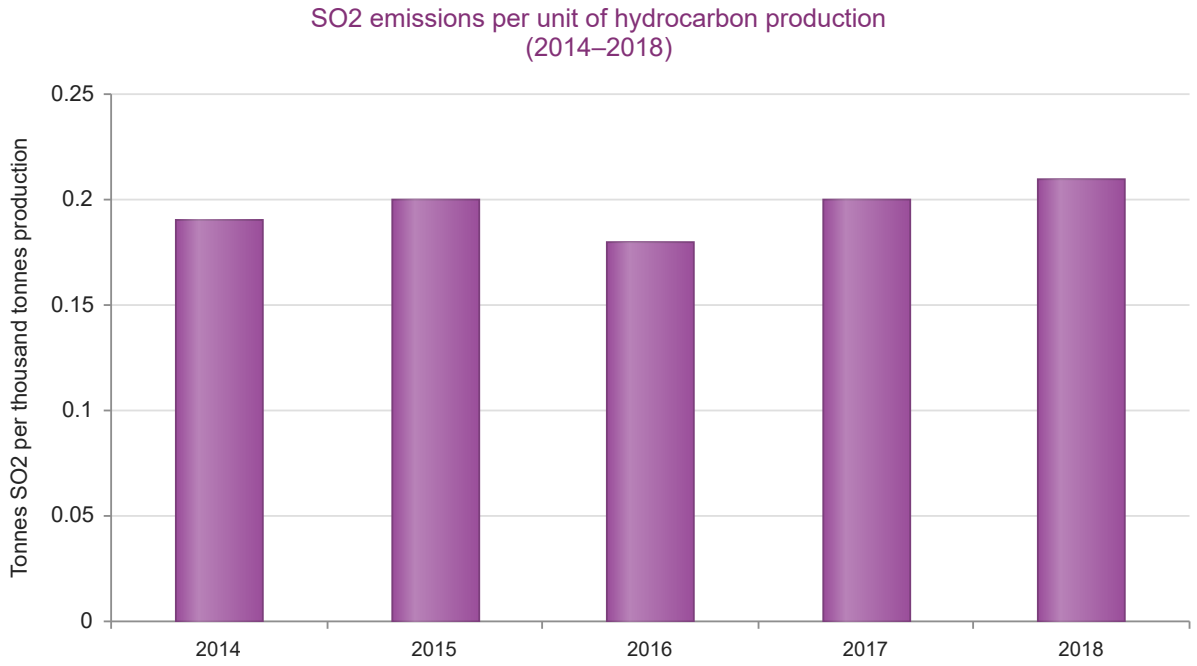


1.5 Sulphur dioxide (SO_2)

Sulphur oxide emissions by the E&P industry arise through oxidation during combustion of sulphur naturally contained within fuel gas or flared gas (H_2S content) and within diesel and other liquid fuels (sulphur content).

Overall, SO_2 emissions normalized to hydrocarbon production for 2018 participating companies were 0.21 tonnes of SO_2 per thousand tonnes of production, 5% higher than the average result for the 2017 participating companies, as shown in Figure 19.

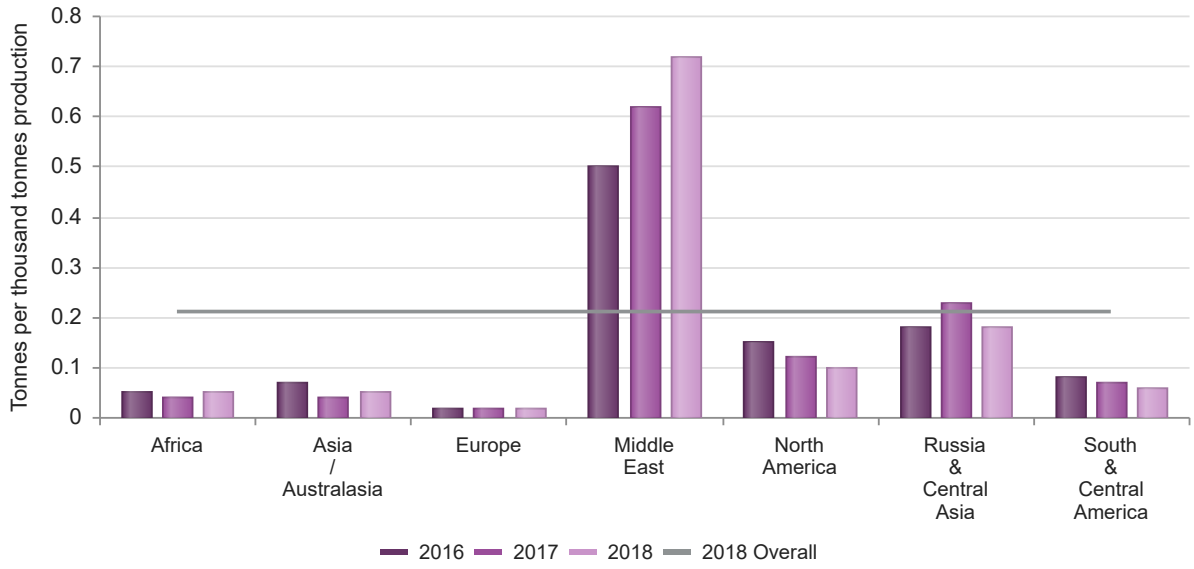
Figure 19:



In 2018, regional averages for SO_2 emissions expressed per unit of production varied from 0.0 to 0.7 tonnes of SO_2 per thousand tonnes of hydrocarbon production, as shown in Figure 17. In 2017, the range was between 0.0 and 0.6 tonnes per thousand tonnes of production.

Figure 20:

SO2 emissions per unit of hydrocarbon production by region (2016–2018)

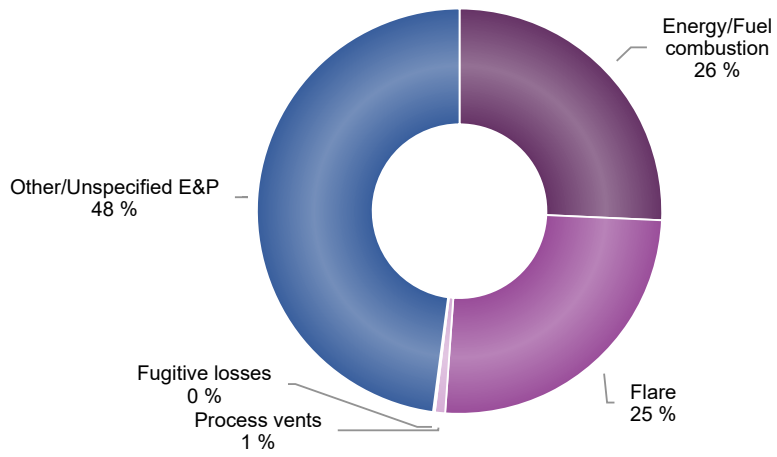


Emissions by source

The source was specified for 52% of the SO_2 emissions reported for 2018. 25% of the reported SO_2 emissions were from flaring, 26% were from energy use, 1% were from venting or vents (including venting, vessel loading, tank storage, pneumatic devices, etc.), and 0.15% were from fugitive losses, as shown in Figure 21.

Figure 21:

SO2 emissions by source (2018)

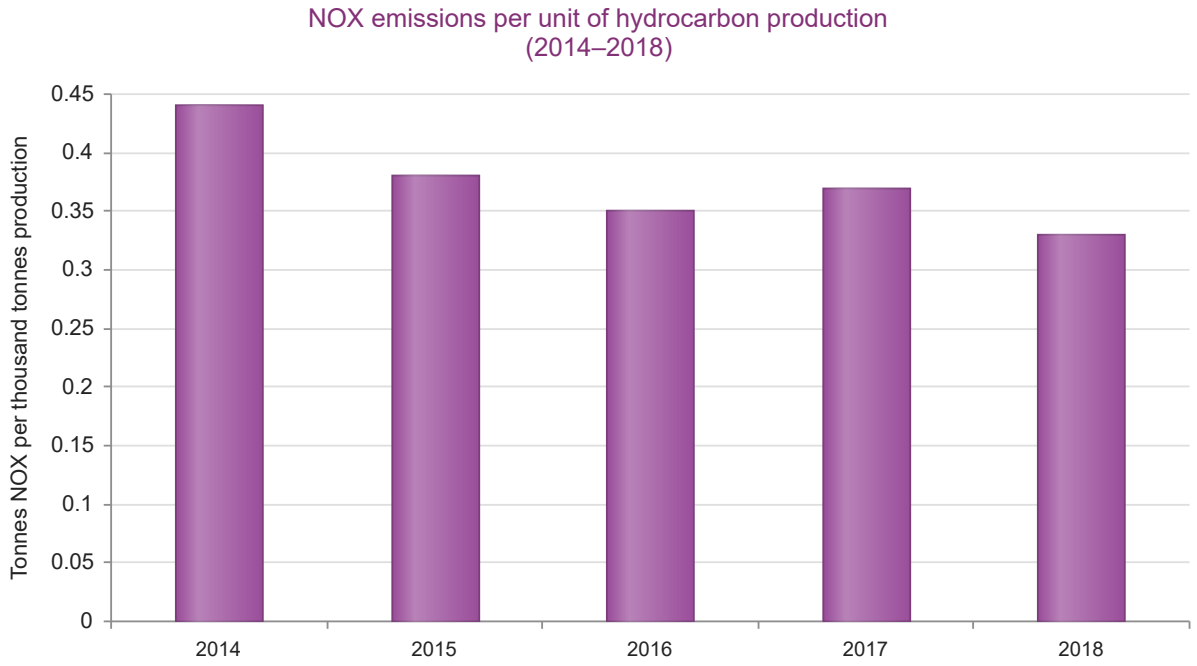


1.6 Nitrogen oxides (NO_X)

Emissions of nitrogen oxides (principally nitric oxide and nitrogen dioxide, expressed as NO_X) occur almost exclusively from the combustion of natural gas or other fuels. These emissions are heavily influenced by energy use and are also a function of the combustion equipment, loading and technology.

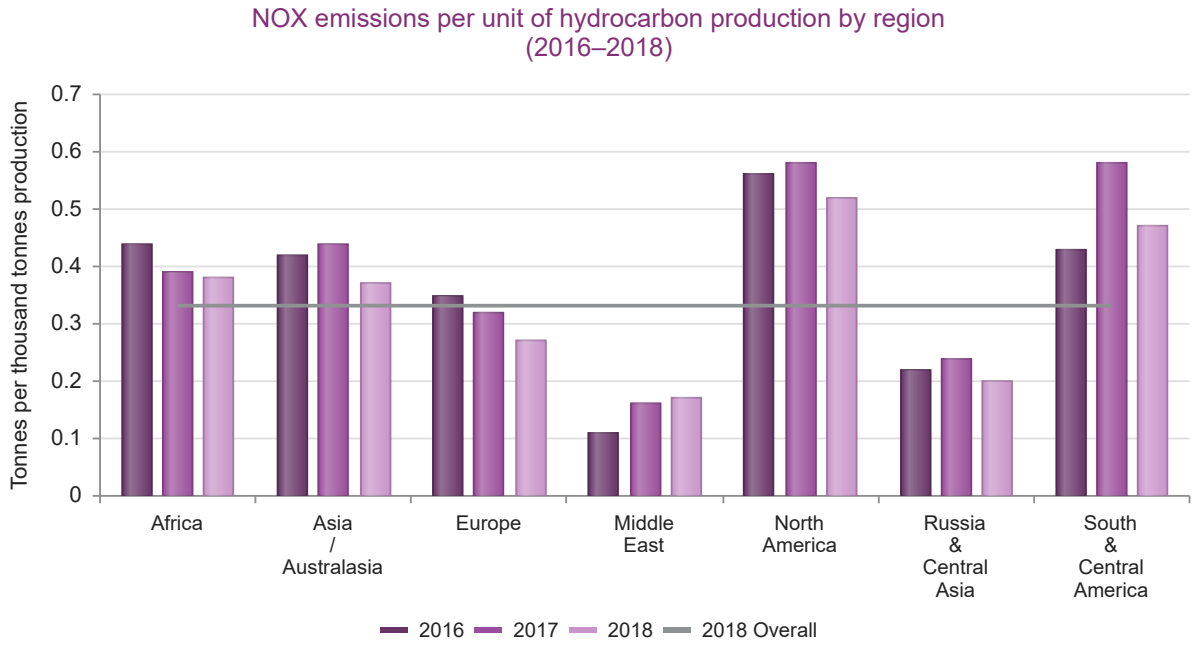
Overall, NO_X emissions normalized to hydrocarbon production for 2018 participating companies were 0.33 tonnes of NO_X per thousand tonnes of production, 11% lower than the average result for the 2017 participating companies, as shown in Figure 22.

Figure 22:



In 2018, regional averages for NO_X emissions expressed per unit of production varied from 0.2 to 0.5 tonnes of NO_X per thousand tonnes of hydrocarbon production, as shown in Figure 17. In 2017, the range was between 0.2 and 0.6 tonnes per thousand tonnes of production.

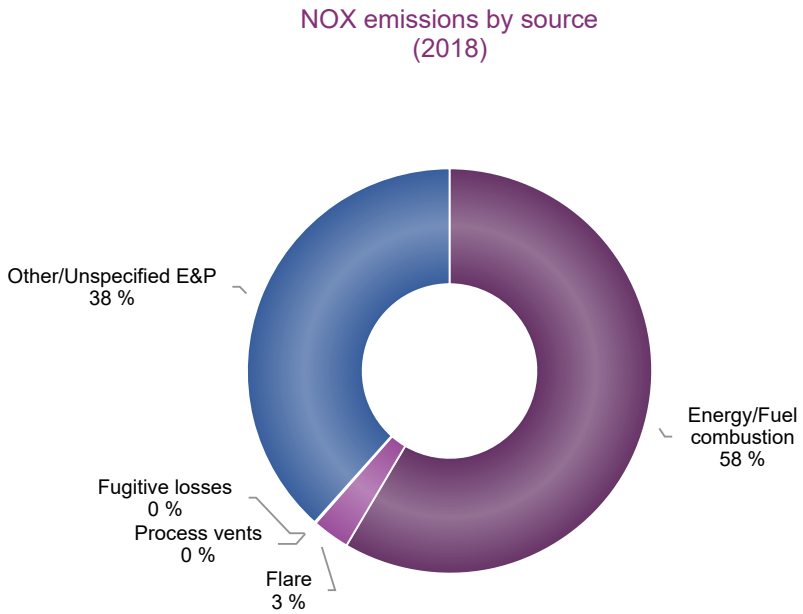
Figure 23:



Emissions by source

The source was specified for 62% of the NO_X emissions reported for 2018. 58% of the reported methane emissions were from energy use, 3% were from flaring, and 3% were from venting or vents (including venting, vessel loading, tank storage, pneumatic devices, etc.), as shown in Figure 24.

Figure 24:



2. Energy consumption

The energy used to produce oil and gas covers a range of activities. These include:

- powering compressors to re-inject produced gas or to export it through pipelines
- driving turbines to generate electricity needed for operational activities, including logistics, and for living quarters (e.g., at offshore platforms)
- driving pumps that produce the hydrocarbons (and any associated produced water)
- heating produced oil for separation
- producing steam for enhanced oil recovery
- driving the pumps to reinject produced water, inject water for waterflooding and transport the produced oil through pipelines

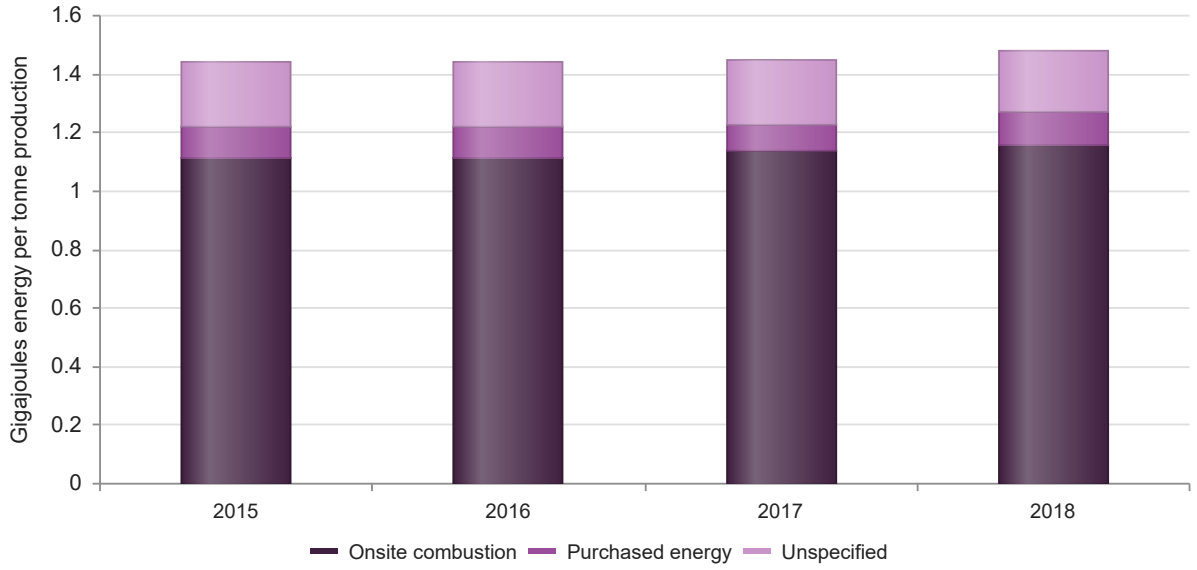
Energy consumption will vary widely depending upon the specific local circumstances and operational conditions. For example, mature or remote fields usually consume more energy than other fields.

In 2018, IOGP reporting companies consumed on average 1.5 gigajoules of energy for every tonne of hydrocarbon produced, as shown in Figure 25. This is 2% higher compared with the 2017 average.

As in previous years, data indicate that onshore production in 2018 was more energy intensive than offshore production (see data table A.10).

Figure 25:

Energy consumed per unit of hydrocarbon production – by source (2014–2018)



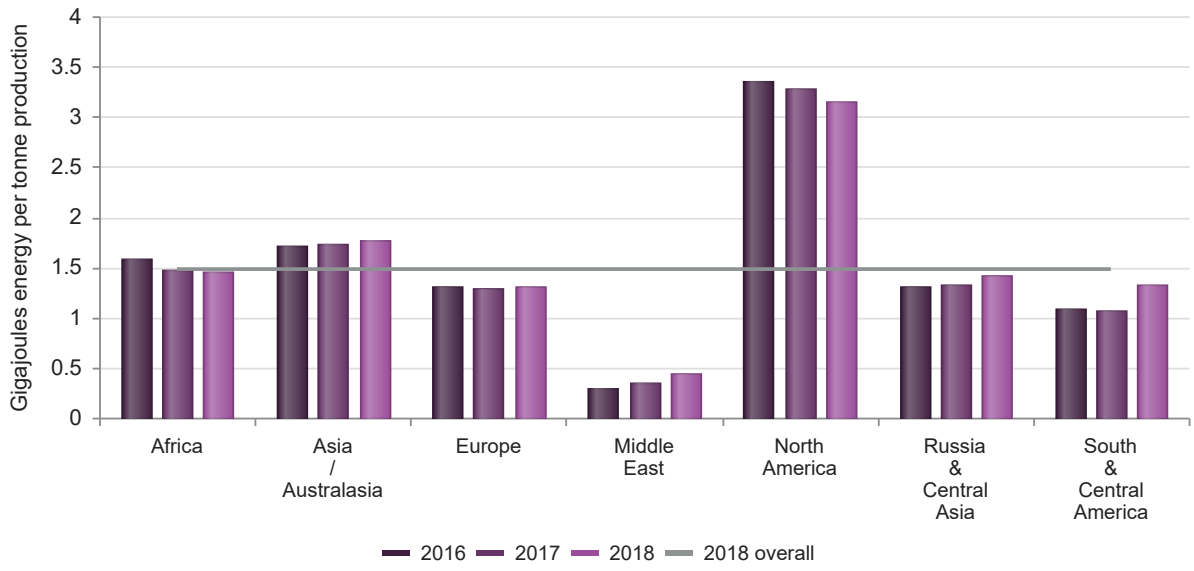
The source of energy used was specified for 86% of the energy reported by participating companies in 2018. Where specified, the majority of energy requirements were met by the combustion of fuels onsite (fuel gas, natural gas, liquid fuels) rather than by purchase of electricity or steam.

In Figure 26, the (overall) energy consumption is normalized against the quantity of hydrocarbons produced for each region.

The wide range across regions points towards the strong influence of different types of production assets on the metric.

Figure 26:

Energy consumption per unit of hydrocarbon production by region (2016–2018)



3. Flaring

Flaring is the controlled burning of hydrocarbons produced during petroleum exploration and production operations. It includes the controlled and safe burning of gas that is not used or exported for safety or technical reasons, for lack of export infrastructure, or for lack/absence of sufficient facilities or amenable geology to reinject the produced gas.

Despite some differences in the performance of individual companies or regions, it is apparent that there is an overall continual reduction in flaring.

In 2018, participating companies reported 22,348 thousand tonnes of gas flared. This equates to 10.5 tonnes of gas flared for every thousand tonnes of hydrocarbon produced versus 12.1 in 2017 and 12.9 in 2016, as shown in Figure 27.

Figure 27:

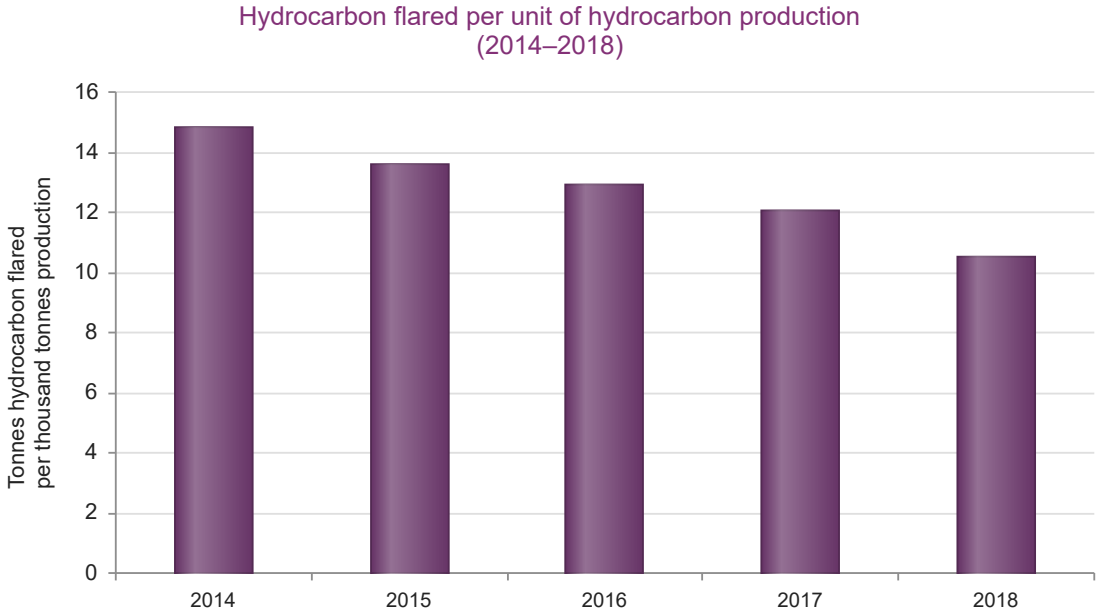
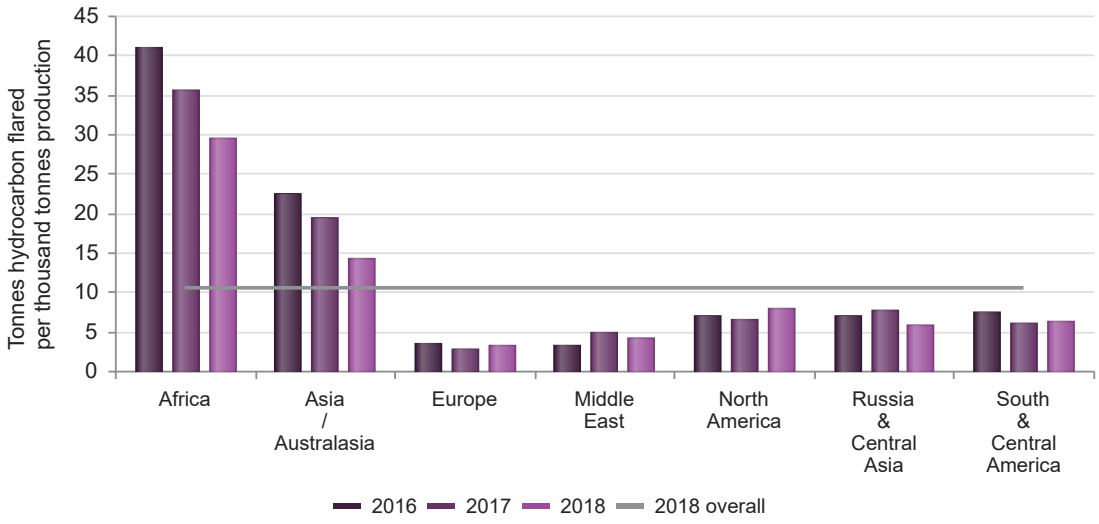


Figure 28 shows flaring per unit of hydrocarbon production for the participating companies, by region.

Flaring intensities for the participating companies are higher in Africa than in other regions, due in part to a relative lack of infrastructure to allow utilization of the gas. But efforts to improve the utilization via reinjection and gas export have led to reduced intensities in Africa in recent years.

Figure 28:

Hydrocarbon flared per unit of hydrocarbon production by region (2016–2018)



4. Produced water

Produced water is often generated during the production of oil and gas. It consists of formation water (water present naturally in the reservoir) and floodwater (water previously injected into the reservoir).

After extraction, produced water is separated and treated (de-oiled) before discharge to surface water (including seas, rivers, lakes, etc.) or to land (including to evaporation ponds). Produced water can also be injected either into the producing reservoir where it can enhance hydrocarbon recovery or into another appropriate formation for disposal. The volume of produced water typically increases as recovery of oil and gas from a field progresses, that is, as the field becomes 'mature'.

Most countries regulate the discharge of produced water, taking into account differing environmental conditions and sensitivities between onshore and offshore.

The quality of produced water is most widely expressed in terms of its oil content. There are several analytical methodologies in use around the world for measuring oil in water. Due to differences in analytical methodologies, care should be taken when interpreting aggregated data.

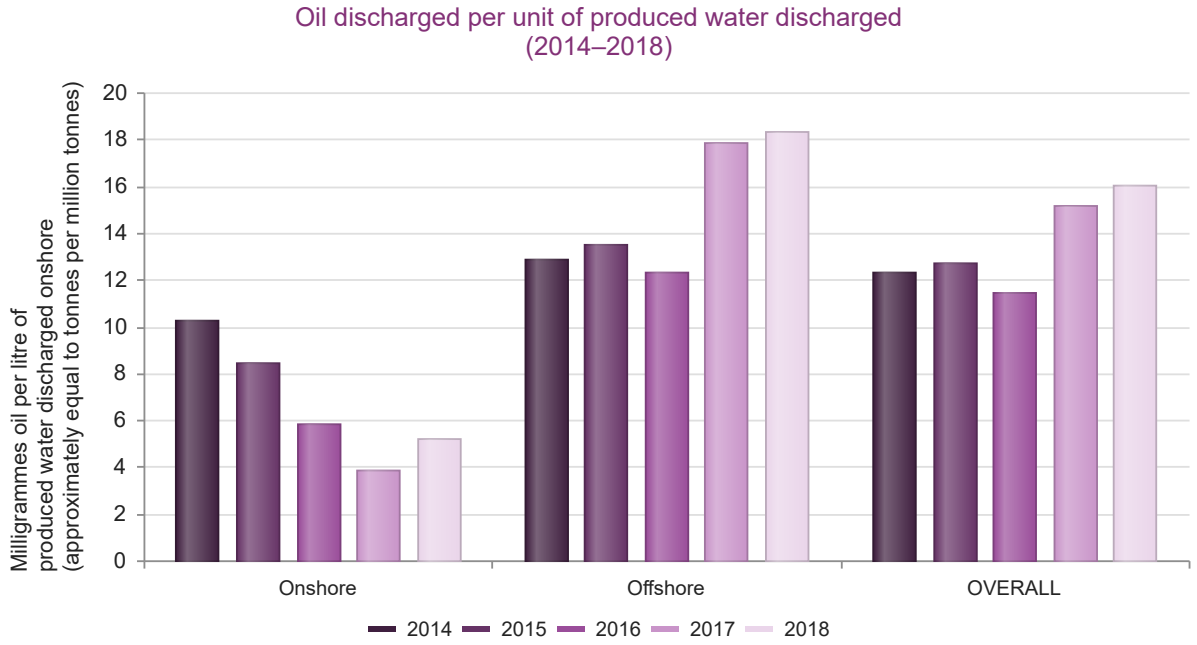
- In 2018, participating companies reported the oil content of 862 million cubic metres of discharged produced water. Where the location was specified, approximately 15% of water discharged was from offshore operations and 85% was from onshore operations.
- An average of 58% of produced water is re-injected versus 42% of produced water discharged to the surface.
- The overall average oil content of produced water discharges was 16.1 mg/l in 2018, compared with 15.2 mg/l in 2017 and 11.4 mg/l in 2016. Offshore the average oil content in produced water in 2018 was 18.3 mg/l, whilst onshore it was 5.2 mg/l (See Figures 29, 30 and 31).
- Overall 6.7 tonnes of oil were discharged per million tonnes of hydrocarbon production in 2018 by participating companies, a 11% reduction compared with 2017 participating companies (7.5 in 2017 and 6.6 in 2016). The quantity of oil discharged per unit of hydrocarbon production was 0.8 t/Mt onshore and 12.3 t/Mt offshore (See Figures 32, 33 and 34).

Note 1: For this analysis produced water discharges from crude oil and natural gas facilities are categorized by the source of production and not the location where the discharges occur. In other words, where production is offshore the discharges are reported as "offshore" even if the discharges are generated from an onshore facility.
Note 2: For various reasons companies either discharge or re-inject produced water. The split between the produced water injected and discharged may change over time and this may influence the quantity and concentration of oil in produced water discharged to surface.
Note 3: There are marked differences in the companies providing data for each region between the years, onshore and offshore.

4.1 Concentration (oil content) of produced water discharges

The global quantity of oil discharged per unit of produced water was 16.1 mg/l for 2018 participating companies, 6% higher than the average for 2017 participating companies (15.2 mg/l).

Figure 29:

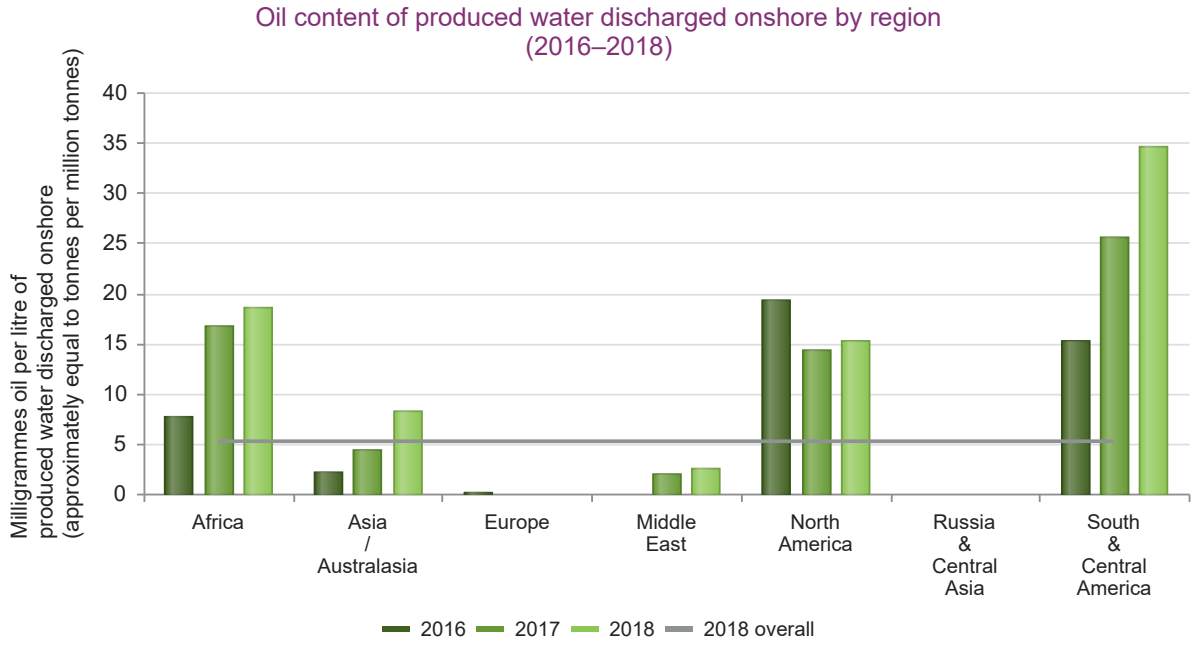


Onshore results were 33% higher compared with 2017. Offshore the average was 2% higher compared with 2017.

The onshore database for the concentration of oil discharged in produced water for South & Central America was affected, in 2016, substantially by improvements in produced water monitoring (volumes and oil content) by some reporting companies and, in 2017 and 2018, by a reduction in reported operations resulting in a reduction in produced water discharges.

The higher oil content onshore in 2017 in Africa is also attributed to a change in assets. The reduction in North America is due to platform shut-ins.

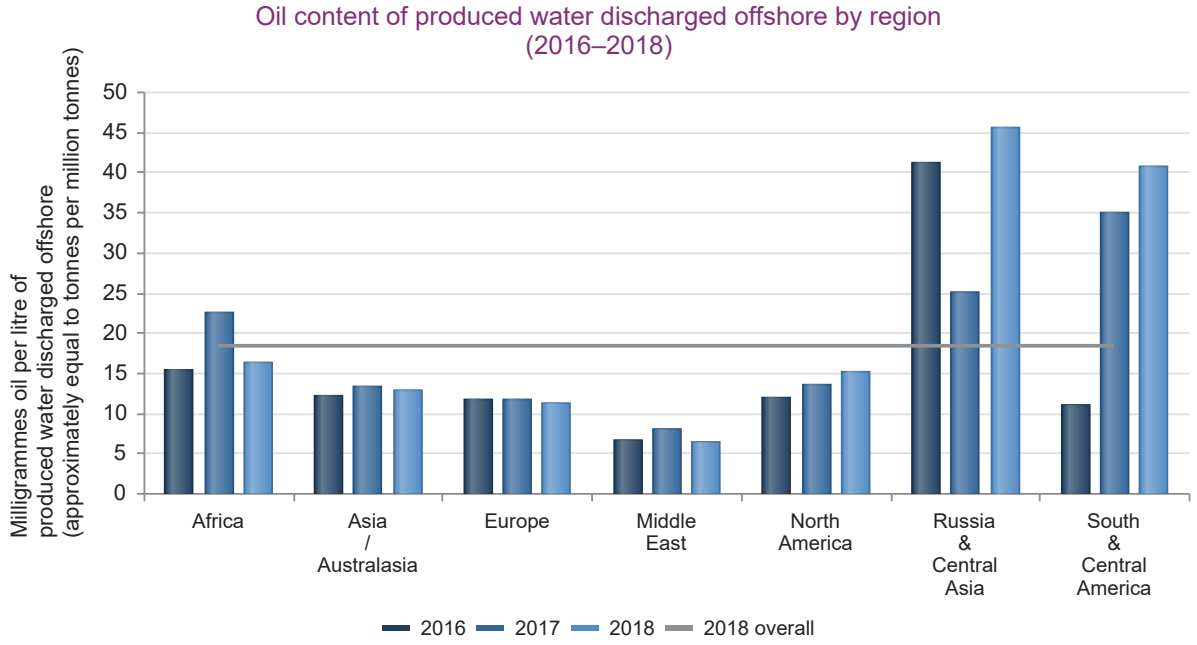
Figure 30:



The offshore database for the concentration of oil discharged in produced water for South & Central America was affected substantially, in 2017, by an increase in the volume of water discharged as well as changes in the analysis methodology driven by updated regulatory requirements.

In 2018 the higher oil content offshore for Russia & Central Asia was due to increased produced water re-injection offshore.

Figure 31:

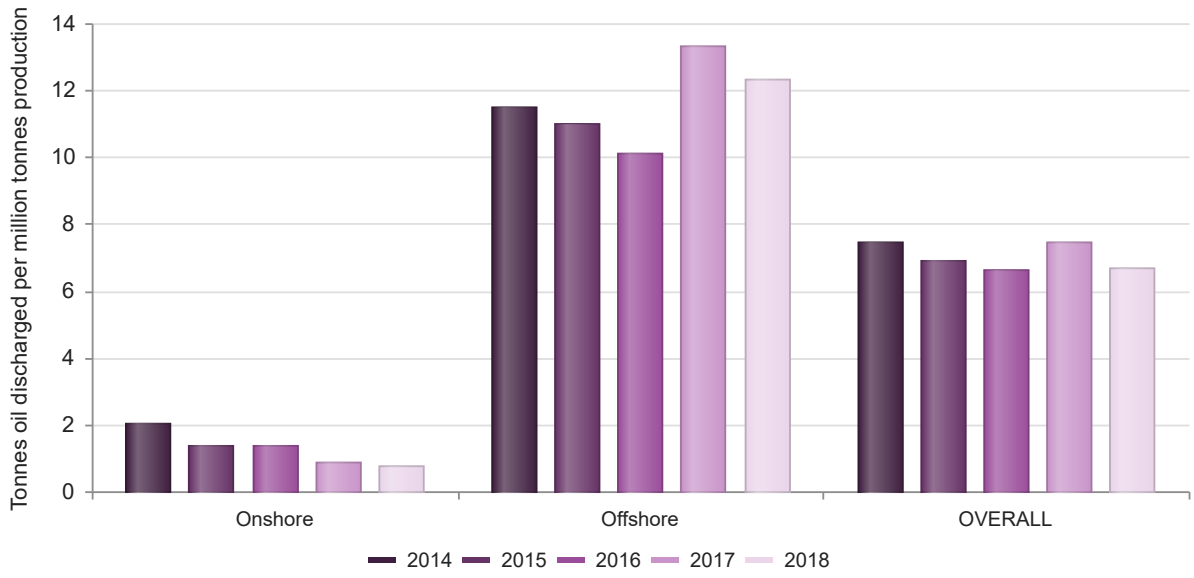

Oil content of produced water discharged offshore by region
(2016–2018)
Milligrammes oil per litre of produced water discharged offshore (approximately equal to tonnes per million tonnes)
50
45
40
35
30
25
20
15
10
5
0
Africa
Asia / Australasia
Europe
Middle East
North America
Russia & Central Asia
South & Central America
2016
2017
2018
2018 overall

4.2 Quantity of oil discharged in produced water per unit of production

Overall the rate of oil discharged per unit of production for participating companies in 2018 shows a 11% reduction compared with the average for 2017 participating companies.

Figure 32:

Oil discharged in produced water per unit of hydrocarbon production (2014–2018)



The difference between the overall averages onshore and offshore reflects the fact that produced water is largely re-injected onshore (where environmental sensitivities to produced water – especially saline water – are generally higher) while the offshore environment is generally less sensitive to produced water discharges.

Regional averages for the quantity of oil discharged per unit of hydrocarbon production in 2017 varied, onshore (see Figure 33), from minimum levels in Europe, to 3.2 t/106 t in Asia/Australasia. Offshore (Figure 34) they varied from almost zero in Russia & Central Asia, to 25.5 t/106 t in South & Central America.

Figure 33:

Oil discharged per unit of hydrocarbon production onshore by region (2016–2018)

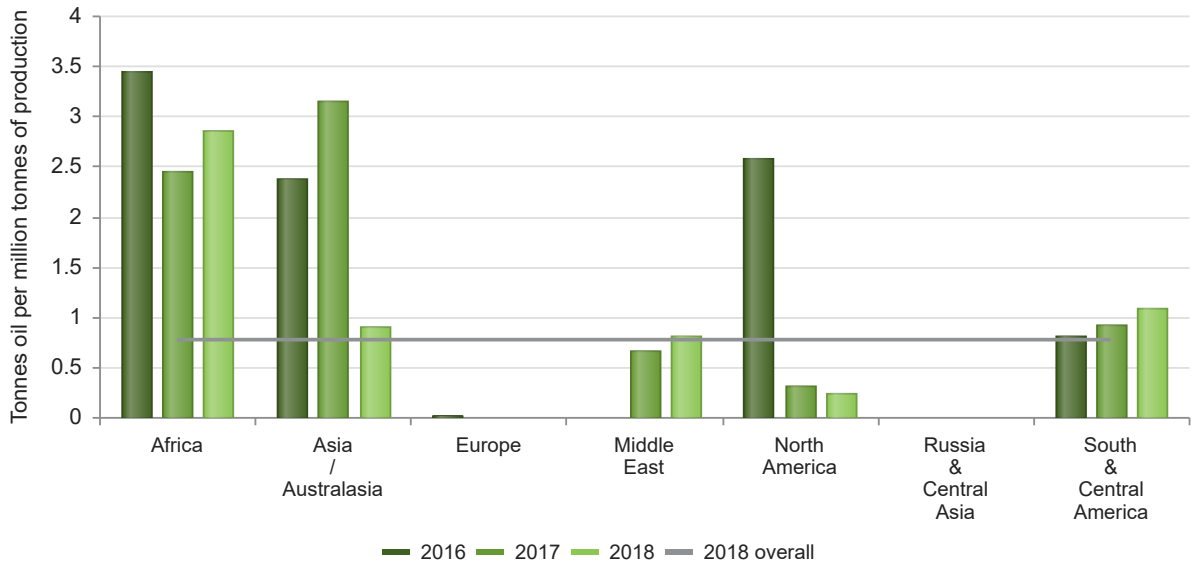
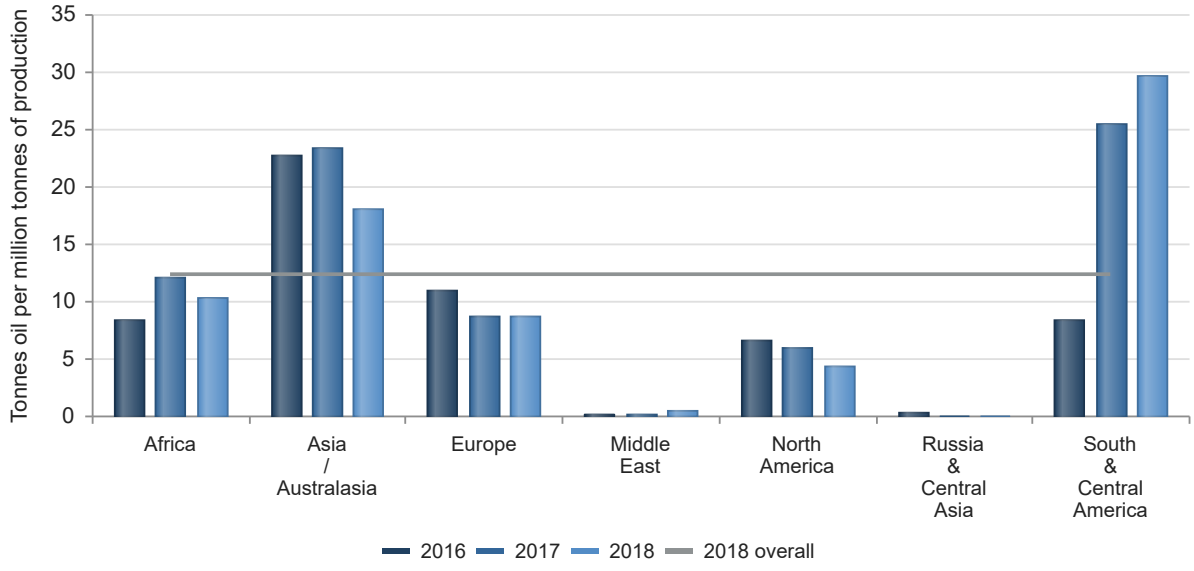


Figure 34:

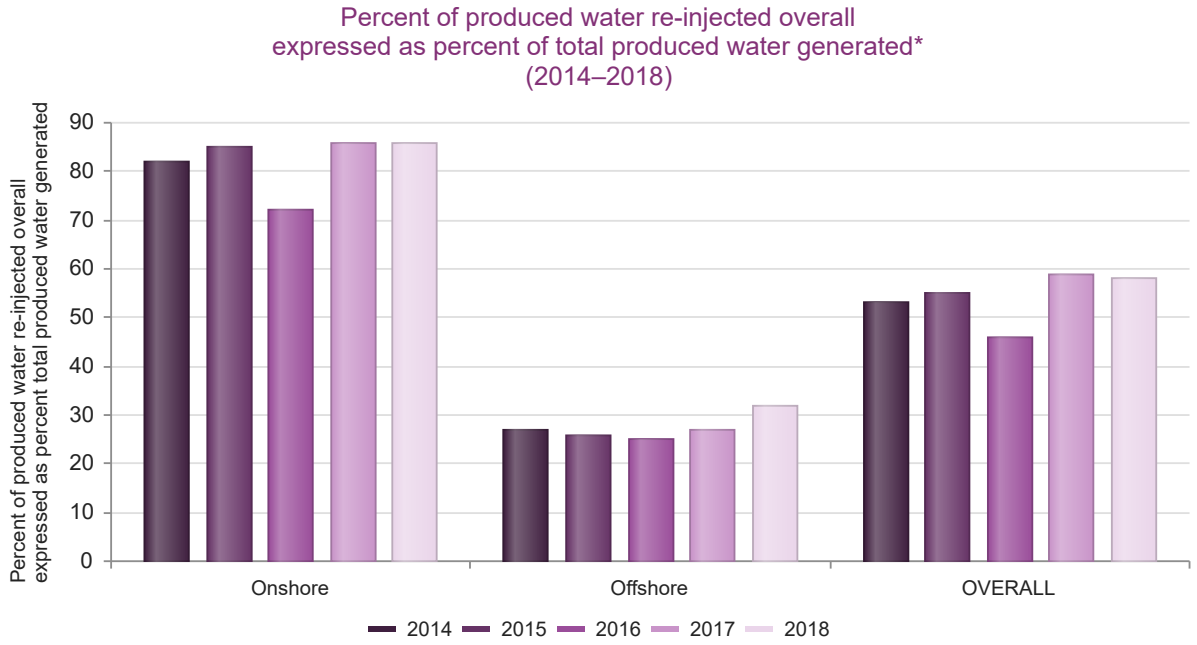
Oil discharged per unit of hydrocarbon production offshore by region (2016–2018)



4.3 Produced water injection

As stated previously, produced water is often injected back into producing reservoirs (reinjection) to improve hydrocarbon recovery or into other geological strata for disposal.

Figure 35:



** total produced water generated: produced water discharged + produced water re-injected.*

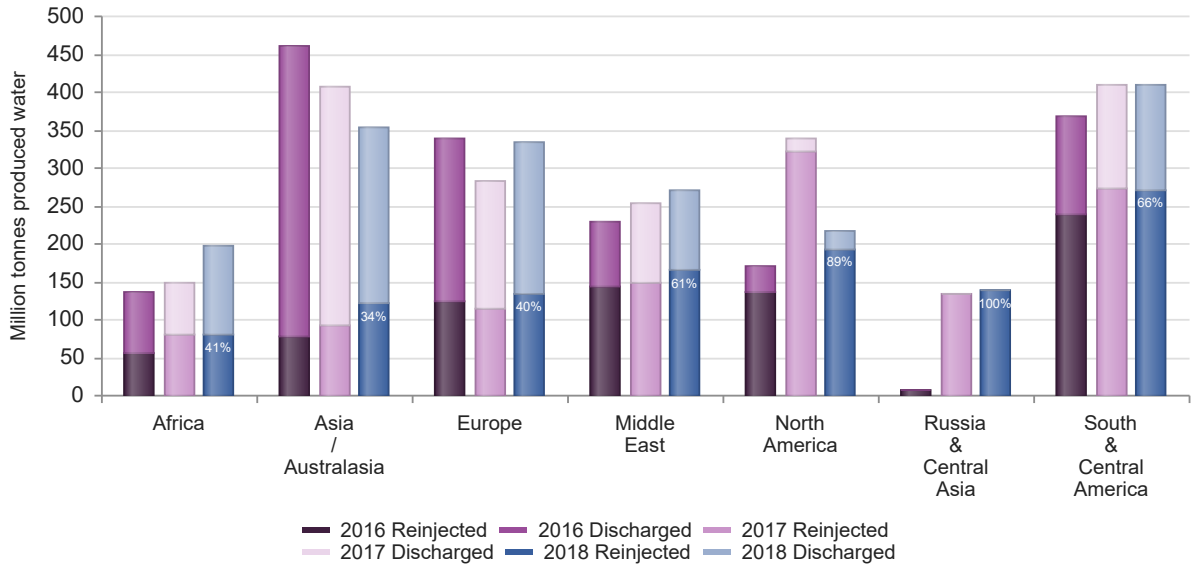
Onshore, where disposal to surface is often constrained by regulatory and environmental concerns, injection of produced water for beneficial reuse or for final disposal are the most common management methods. In 2018, 86% of water produced from onshore assets was returned below ground in data sets where the volumes of re-injected water were provided by reporting companies (see Figure 35).

Offshore, de-oiled produced water can typically be discharged to sea with limited impact, therefore there is much less reinjection (32% in 2018 for data sets with reinjection data). Nevertheless reinjection may be pursued in locations where it would be beneficial to the management of the reservoir and water chemistry allows for reinjection or where environmental sensitivity is considered to be high.

While the average is 32% offshore, there is a large variation between the regions. For example, participating companies in the Russia & Central Asia region reported that 100% of the offshore produced water was reinjected, while in North America 7% of offshore produced water was reinjected by participating companies in 2018 (see data table A.18).

Figure 36:

Produced water re-injected and produced water discharged (2016–2018) - by region



5. Non-aqueous drilling fluids retained on cuttings discharged to sea

While much of the drilling in the offshore oil and gas industry is achieved using water-based drilling fluids (muds), technical challenges often require the use of non-aqueous drilling fluids (NADF) that provide higher lubricity, better performance at higher temperatures and enhanced well-bore stability compared with water-based muds.

These challenges arise especially with techniques such as extended-reach and directional drilling, either or both of which may be required to develop new reservoirs or to improve recovery from previously identified resources.

IOGP reports non-aqueous base fluids (NABFs) according to the classifications in Table 3.

Table 3. NABF classifications

Classification	Base fluid	Aromatic (%)	PAH (%)
Group I	Diesel and Conventional Mineral Oil	>5.0	>0.35
Group II	Low Toxicity Mineral Oil	0.5 – 5.0	0.001 – 0.35
Group III	Enhanced Mineral Oil Synthetics (esters, olefins, paraffins)	<0.5	<0.001

Classification is defined in IOGP Report 543 - Environmental fate and effects of ocean discharge of drill cuttings and associated drilling fluids from offshore oil and gas operations.

In the past, diesel-based and mineral oil-based fluids (Group I fluids) were used to address these technical challenges, but it was recognised that the discharge of cuttings with adhering diesel or oil-based muds might cause adverse environmental impacts.

Less harmful low-toxicity mineral oil fluids (Group II, with reduced aromatic content) and later more sophisticated drilling fluids (Group III, with low to negligible aromatic content) were developed to deliver high drilling performance while ensuring that any discharges of drilling fluids adhering to cuttings or whole mud posed minimal threat to the marine environment.

Non-aqueous drilling fluids (NADF) contain more than 30% non-aqueous base fluid (NABF) as a continuous phase (typically 50%–80% by volume). The remainder consists of brine, barite and other materials such as gels and emulsifiers.

The data gathered for this report relate to NABF adhering to cuttings that are discharged to the marine environment. NADFs as such are not directly discharged.

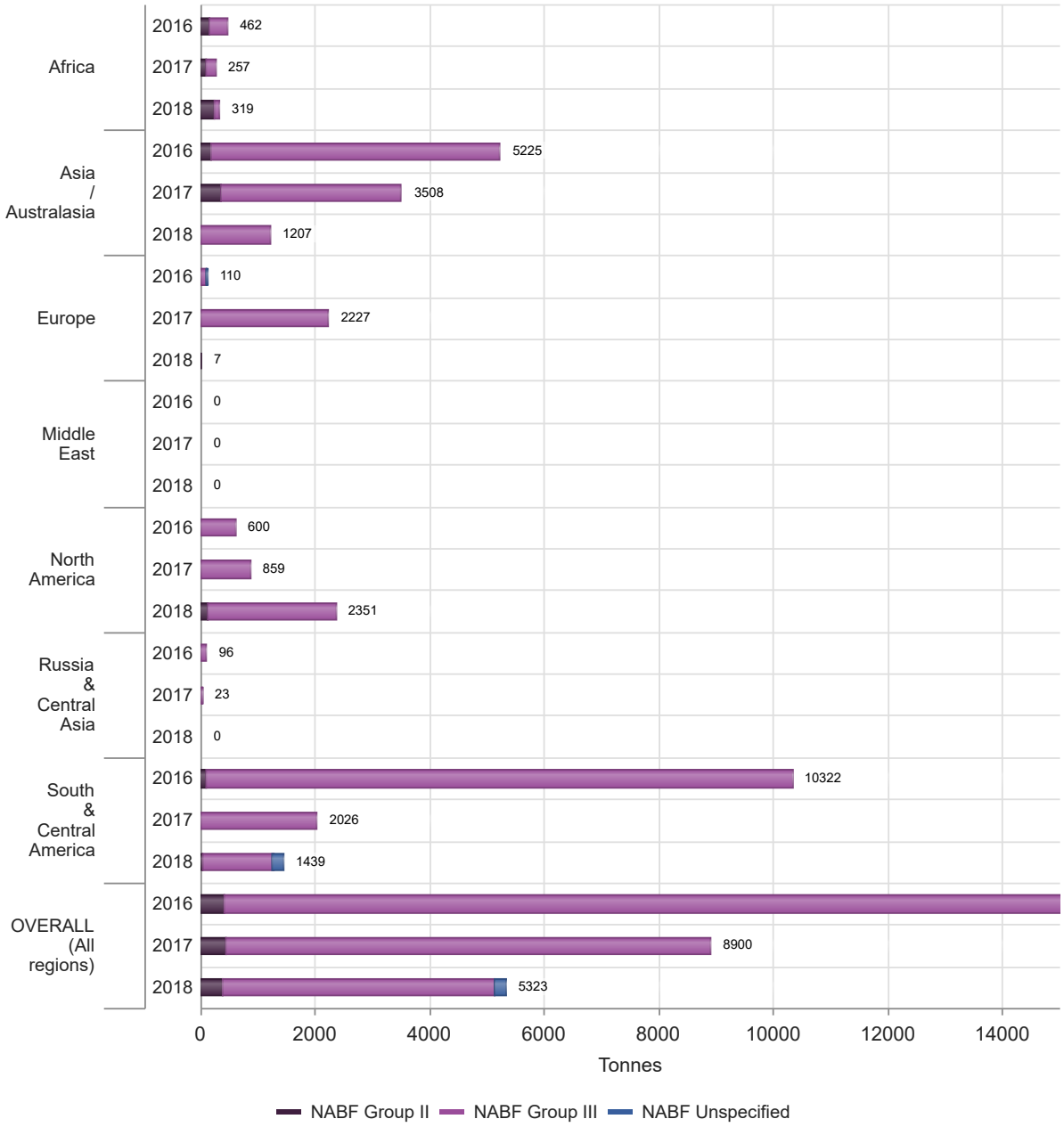
Figure 37 provides a regional view of adhered base fluid quantities on cuttings discharged to the sea while drilling with NADFs. Absolute values rather than normalized values are shown in Figure 37, because drilling activity is not directly linked to hydrocarbon production. The number of wells drilled in a given year is influenced by many factors including the prices of oil and natural gas as well as other economic factors. Absolute volumes reported can also vary with the number or mix of companies contributing cuttings-related data between years.

Information on NABF discharges in 2018 has been provided by 21 of the 30 companies that reported offshore hydrocarbon production.

Analysis shows, for the companies reporting NABF retained on cuttings in 2018, that most cuttings discharges included Group III fluids (4,763 tonnes, 89% of the total reported), whereas discharges of cuttings with Group II fluids were limited (7% of the total reported). No discharges of cuttings with Group I fluids were reported.

Figure 37:

Total base fluid (NABF) retained
on cuttings discharged to the sea by region (2018)



Note: NABF discharges were reported by [22] of the [26] companies that reported offshore hydrocarbon production in 2018.
[No Group 1 NABF discharges to the sea were reported in the years 2008–2017].

6. Spills

Spills are an important environmental performance indicator for the oil and gas industry since they can have a significant and visible impact on the environment. The environmental impact is highly dependent on the nature of the release, where it occurred, and how it was subsequently managed. Most oil exploration and production companies have spill contingency plans and measures in place to respond to and mitigate spills.

For the purpose of this report, a spill is defined as any loss of containment from which the released material reaches the environment (i.e., is not retained within secondary or other containment). The volume reported represents the total volume that reached the environment, irrespective of quantity of released material that may be recovered.

Spills may have a number of causes such as equipment failure (including corrosion), operating errors, and unlawful third party damage such as sabotage, terrorism and theft.

The majority of spills reported by IOGP Member Companies are oil spills, which include spills of crude, condensate, and processed oil.

For this report 'onshore' refers to operations that take place within a landmass, including swamps, lakes, rivers and estuaries, but excluding major inland seas.

For this report 'offshore' refers to operations that take place at sea, including inland seas directly connecting to oceans. Operations in bays, in major inland seas, e.g., the Caspian Sea, or in other inland seas directly connected to oceans are counted as offshore.

6.1 Oil spills

In 2018, companies reported a total of 7,292 oil spills. Of these, 6,170 (84%) were spills of less than one barrel in volume, amounting to a total of 81 tonnes of oil.

Because of the small cumulative volume involved and, as some companies do not report spills less than 1 barrel in size, these <1 barrel size spills are not included in the detailed analysis provided below.

In 2018, 1,122 spills greater than 1 barrel in size were reported, representing a total of 5,205 tonnes of oil. 87% of the reported oil spills greater than 1 barrel in size (4,586 tonnes) occurred "onshore" (i.e., from assets supporting production of onshore reservoirs) and 9% occurred "offshore" (i.e., from assets supporting production from offshore reservoirs) (414 tonnes). The location was not specified for the remaining 4% (206 tonnes).

Figure 38 shows the total number of oil spills normalized per unit of hydrocarbon production onshore and offshore. The normalized rate for 2018 was 0.5 oil spills per million tonnes of production (0.5 in 2017, 0.4 in 2016). The normalized rate of spills offshore is lower than that onshore.

Figure 38:

Number of oil spills >1 barrel in size per unit of hydrocarbon production (2014–2018)

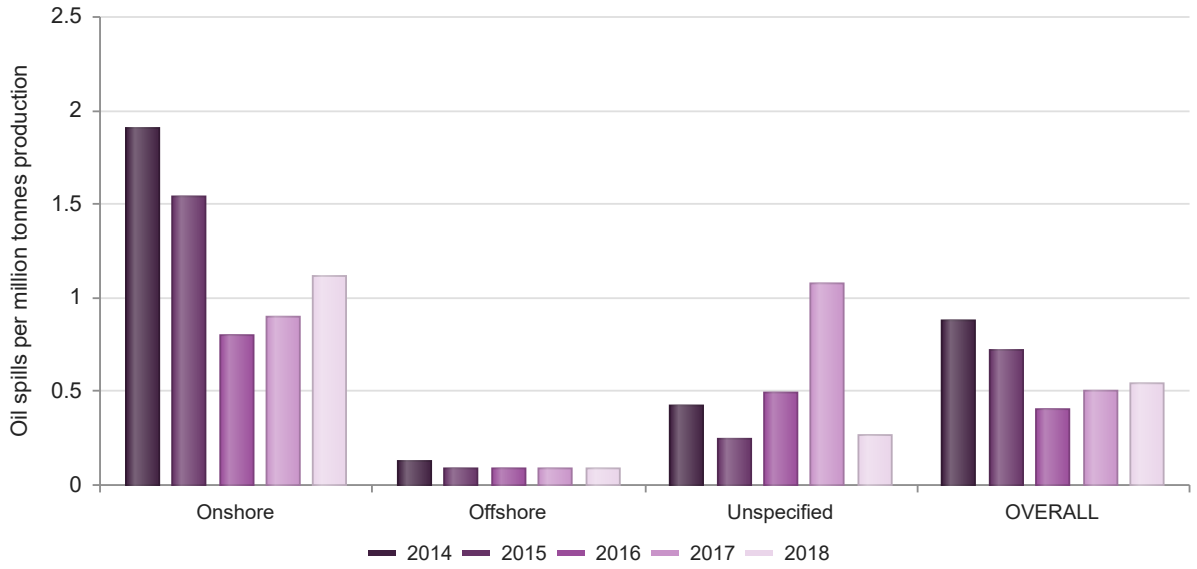
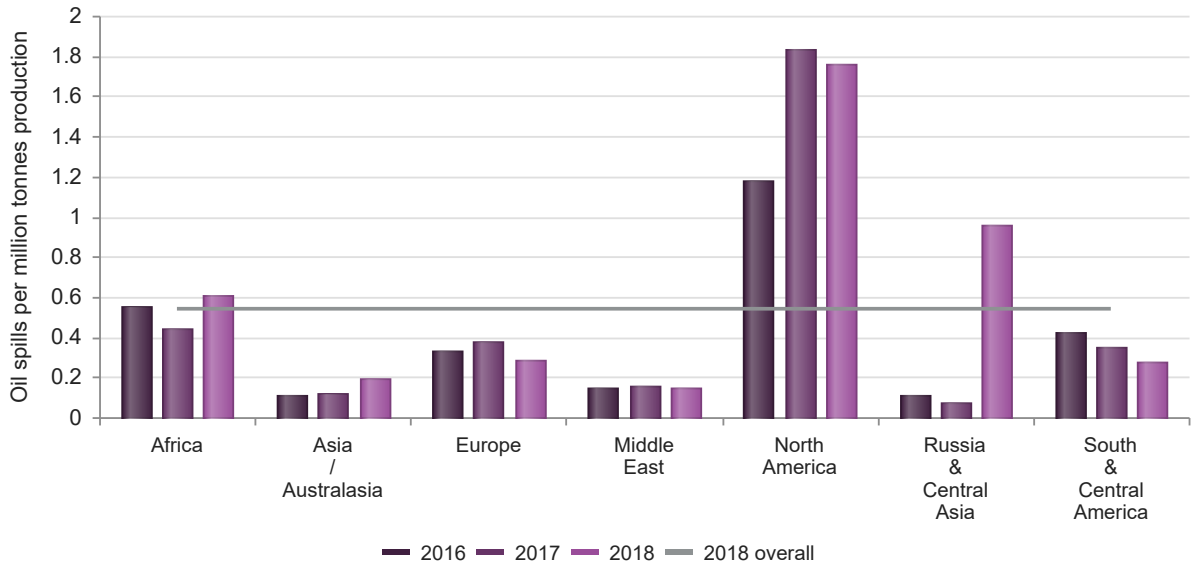


Figure 39 shows the number of oil spills normalized per unit hydrocarbon production by region.

Figure 39:

Number of oil spills >1 barrel in size per unit of hydrocarbon production by region (2016–2018)



The quantity of oil spilled per unit of hydrocarbon production in 2018 shown in Figure 40.

Figure 40:

Quantity of oil spilled per unit of hydrocarbon production (2014–2018)

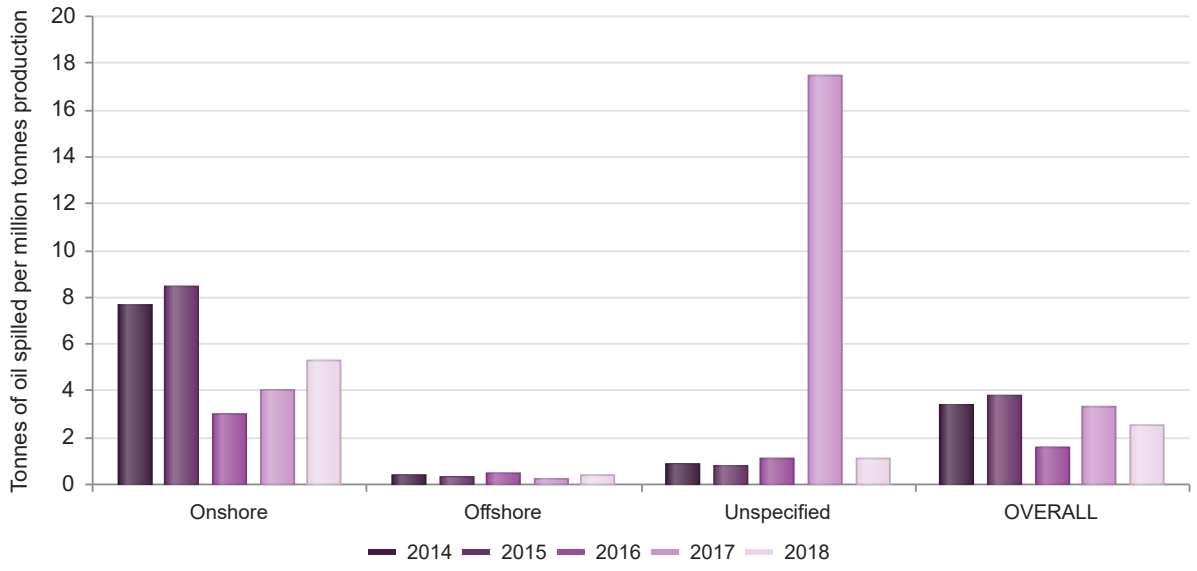


Figure 41:

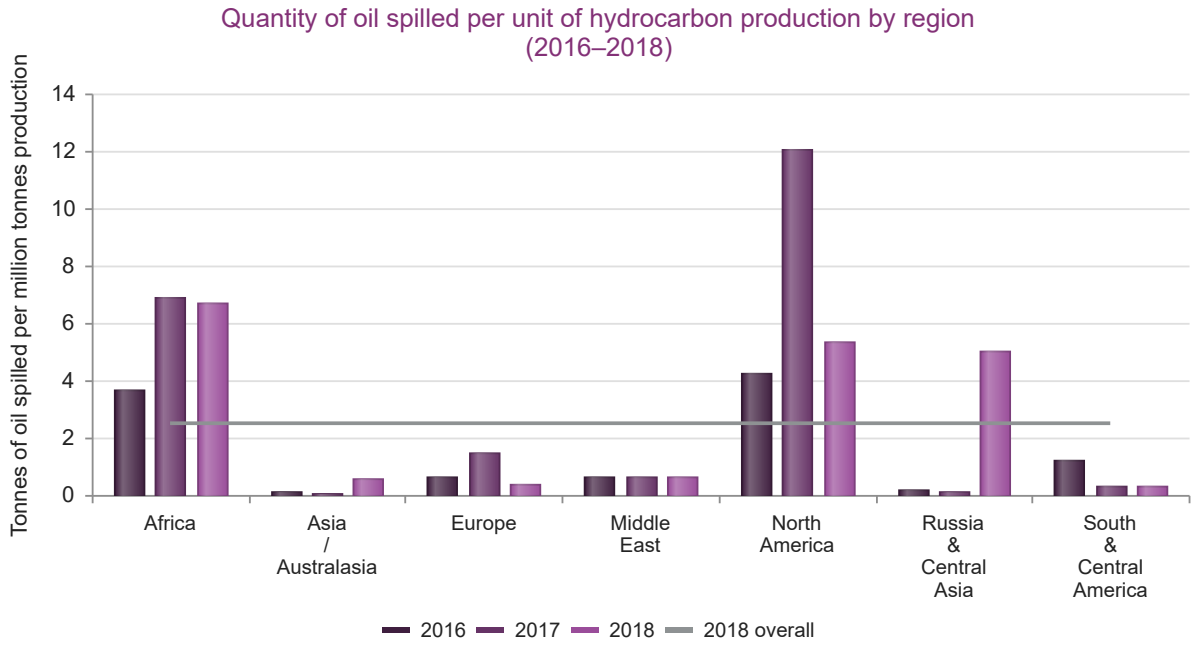


Figure 42:

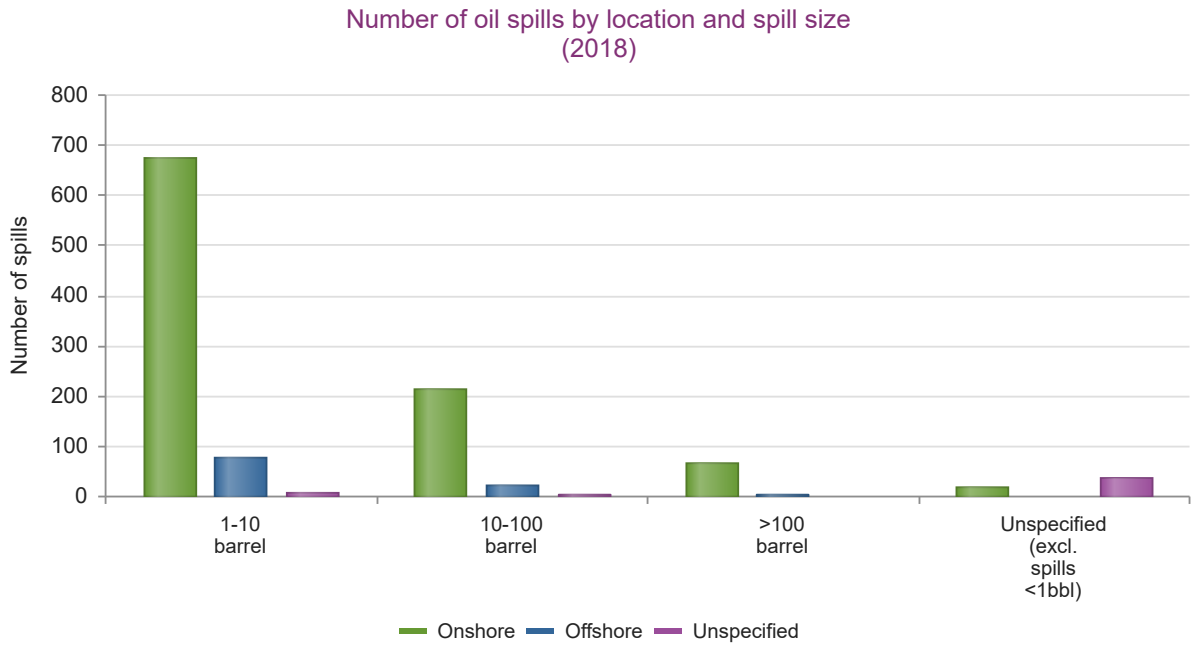
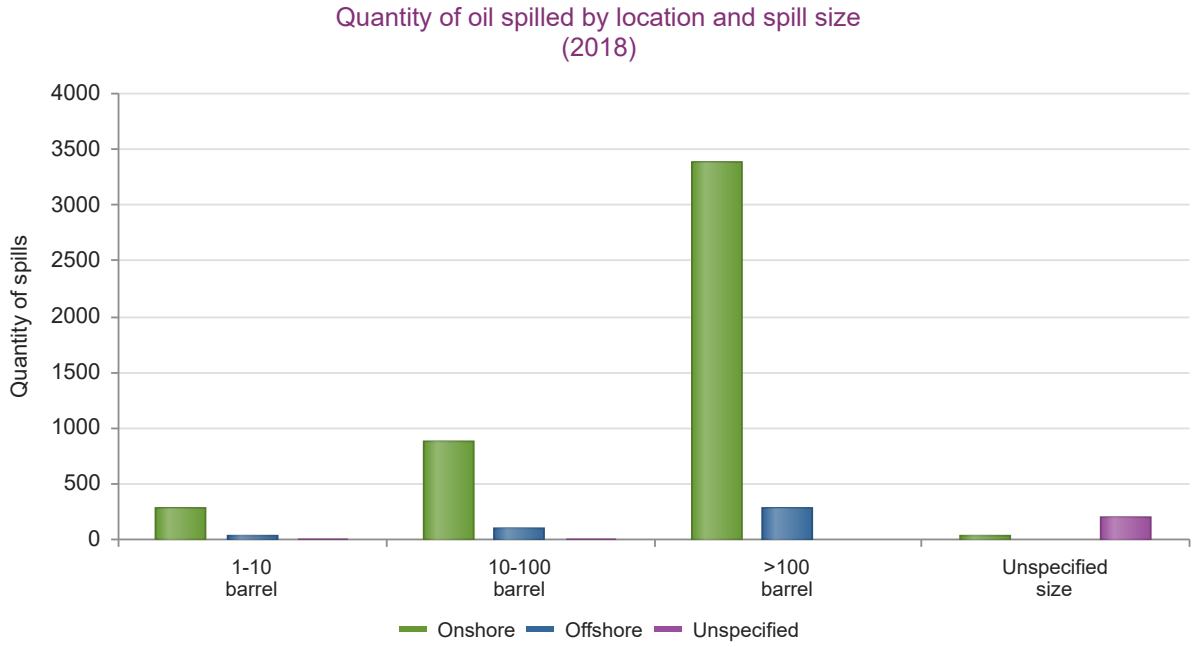


Figure 43 shows the distribution of oil spills larger than 1 barrel in terms of number of spills in each size category for 2018. In terms of number of events, the distribution is dominated by the number of spills between 1 and 10 barrels in size. However, as indicated in Figure 45, the quantity released overall (for those spills where a size category was specified) is dominated by a few relatively large events; spills >100 barrels in size resulted in 70% of the oil volume reported spilled in 2018 for spills >1 barrel.

In addition to the data shown in Figure 42, a total of 6,170 oil spills (3,737 onshore, 2,432 offshore and 1 unspecified location) of less than 1 barrel in size were reported by participating companies. These were not included in the analyses for the reasons stated previously.

Figure 43:



6.1.1 Oil spills greater than 100 barrels in size

In 2018, participating companies reported 69 spills in which a volume of more than 100 barrels of oil was released (67 onshore and 2 offshore), collectively amounting to 3,662 tonnes released. Participating companies provided incident descriptions for all of the 69 individual incidents.

The 2 largest of the 69 were:

- 292 tonnes (~2,181 barrels) of crude oil was spilled as the result of third party damage (sabotage, theft, vandalism, etc) in Africa.
- 271 tonnes (~2,022 barrels) of crude oil was spilled as the result of Unknown in North America.

Cause (excluding intentional third party damage)

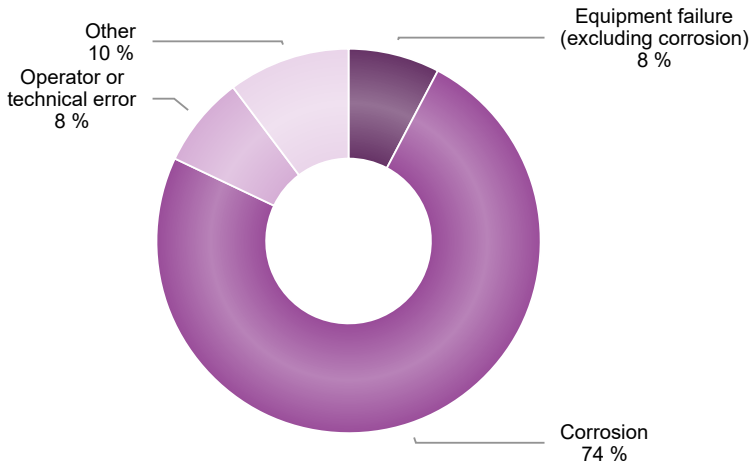
A specific cause was provided for 69 of the oil spills >100 barrels in size in 2018.

Excluding those categorized as third party damage, the remaining 39 spills >100 barrels in size were collectively associated with 58% of the total oil spilled in the larger incidents for which the cause was reported.

Figure 44 shows the distribution of cause, where reported, for operational spill incidents >100 barrels in size for 2018. Corrosion was the leading cause reported for 2018 of larger operational spills that were not induced by third parties.

Figure 44:

Operational oil spills >100 barrels in size by cause excluding third party damage
as % of oil spill incidents >100 barrels where cause was indicated
(2018)



Intentional third party damage (sabotage, theft, vandalism, etc)

Incidents caused by third party damage account for 30 (43%) of the oil spills >100 barrels in size where the cause was reported in 2018. These third party induced spills represent 42% of the oil spills >100 barrels in size for which the cause was reported, and 29% of the total volume reported for all spills >1 barrel in size in 2018.

6.1.2 Oil spills between 10 and 100 barrels in size

In 2018, 238 oil spills between 10 and 100 barrels in size were reported in total (214 onshore, 21 offshore and 3 unspecified location), representing 996 tonnes of oil.

Participating companies provided a specific cause for 236 (99%) of the 238 individual incidents.

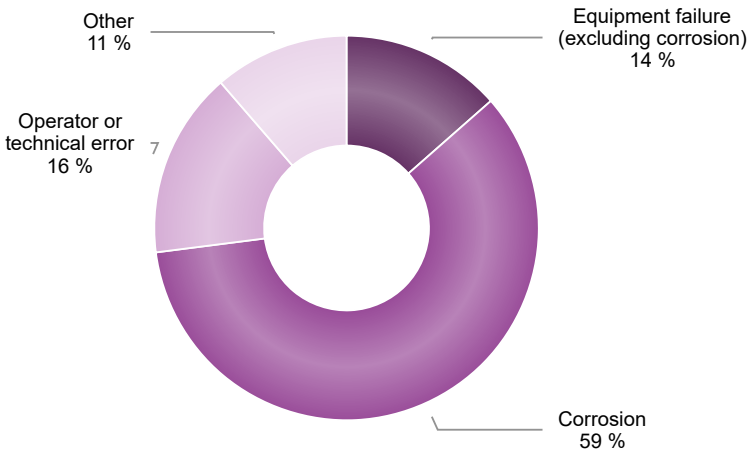
Cause (excluding intentional third party damage)

78% of the 236 oil spills in the 10-100 barrels size category with a specific cause identified were operational spills not induced by third party damage, and they collectively represent 764 tonnes of oil spilled.

Figure 45 shows the distribution of cause, where the cause was reported, for operational oil spill incidents between 10 and 100 barrels in size for 2018. For spills in the 10-100 bbl size range, corrosion was the leading cause reported.

Figure 45:

Operational oil spills 10-100 barrels in size by cause excluding third party damage as % of oil spill incidents 10-100 barrels where cause was indicated (2018)



Intentional third party damage (sabotage, theft, vandalism, etc.)

Incidents caused by third party damage account for 51 (22%) of the spills 10-100 barrels in size where the cause was reported in 2018. These spills caused by third parties represent 226 tonnes of oil, or 23% of the volume reported for cause-specified events in this spill size category.

6.2 Chemical spills

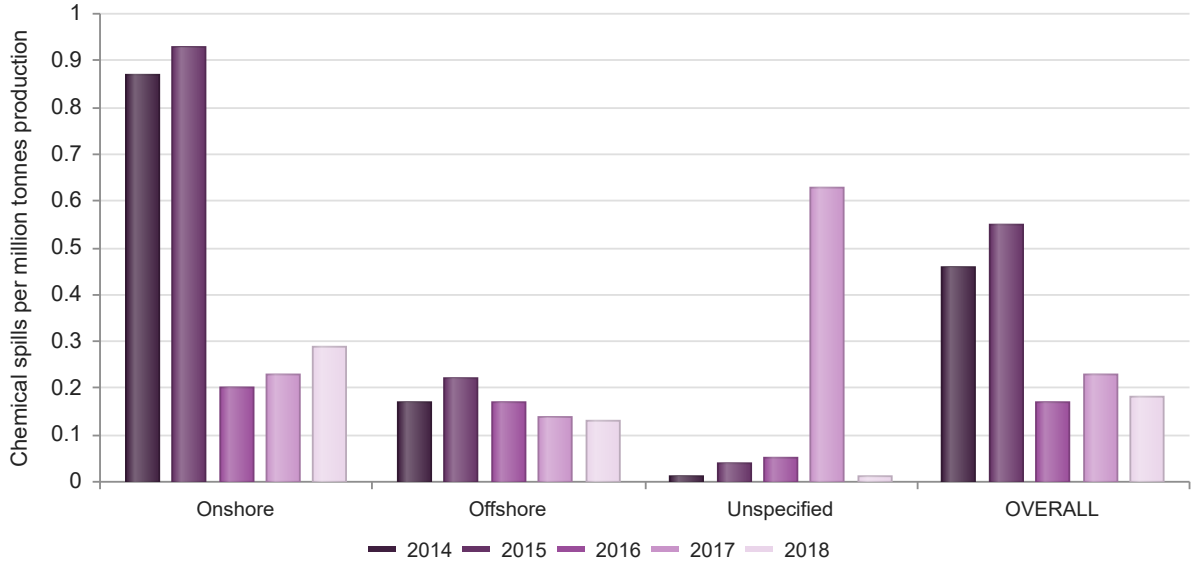
In the E&P sector chemical spills with release to the external environment occur less frequently and quantities released are generally small.

In 2018, participating companies reported 302 chemical spills greater than 1 barrel in size, totalling 3,045 tonnes. Data for these are presented in Tables A.32 and A.33 in Appendix A. Included in these data for some reporting companies are spills of produced water.

Figure 46 shows the total number of chemical spills normalized per unit of hydrocarbon production onshore and offshore. The normalized rate for 2018 was 0.2 chemical spills per million tonnes of production (0.2 in 2017, 0.2 in 2016).

Figure 46:

Number of Chemical spills >1 barrel in size per unit of hydrocarbon production (2014–2018)



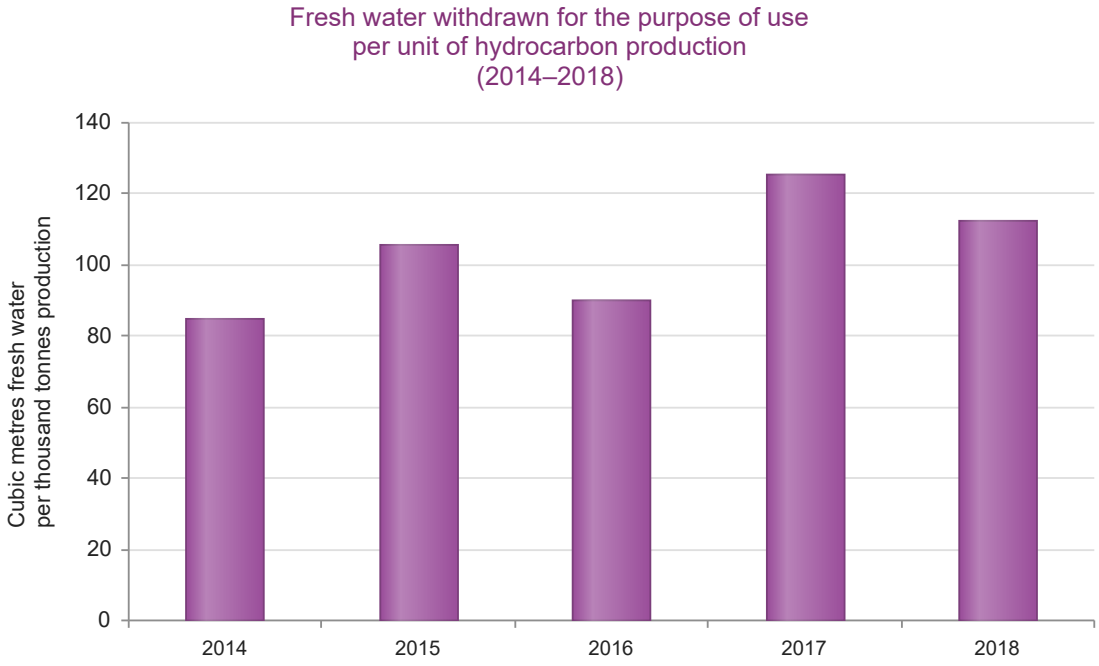
7. Fresh water

The definition of fresh water varies in accordance with local statutes and regulations. Where it is not defined by local regulations, fresh water is defined for reporting purposes as non-brackish water and may include drinking water, potable water, water used in agriculture, etc. The total dissolved solids (TDS) concentration of this water type is up to 2,000 mg/l.

Normalized results for fresh water withdrawn for the purpose of use per unit of hydrocarbon production are shown in Figures 47 and 48.

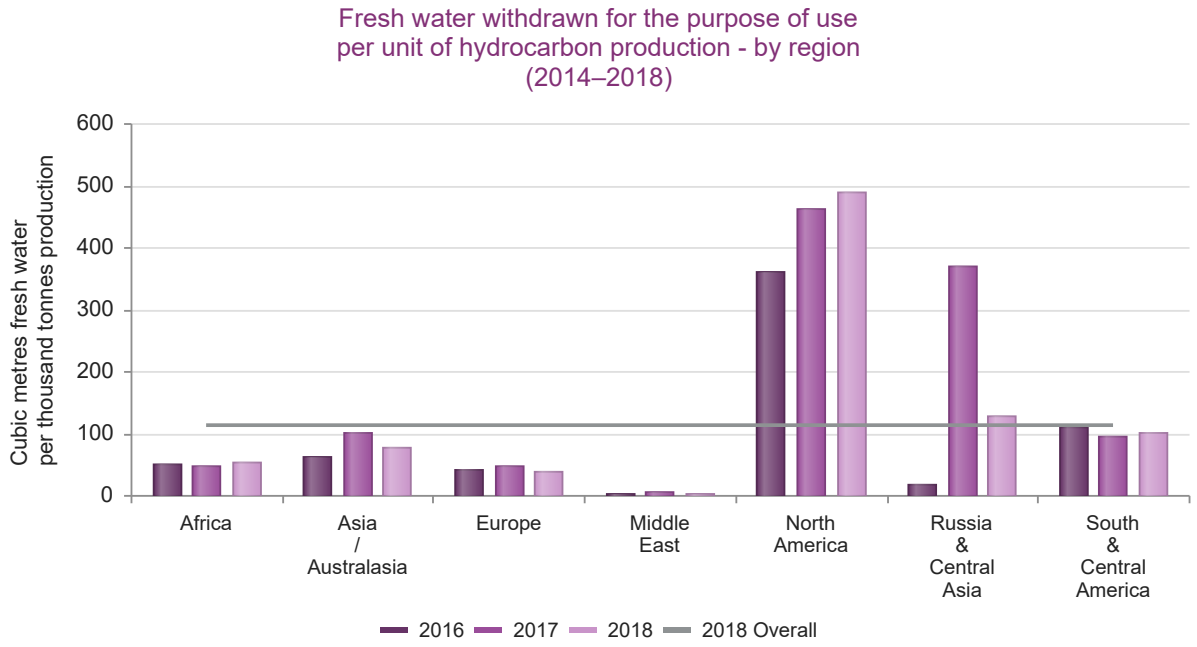
Participating companies reported a total of 181 million cubic metres of freshwater withdrawn for use. This equates to 112.6 cubic metres of fresh water for every thousand tonnes of hydrocarbon produced, as shown in Figure 48.

Figure 47:



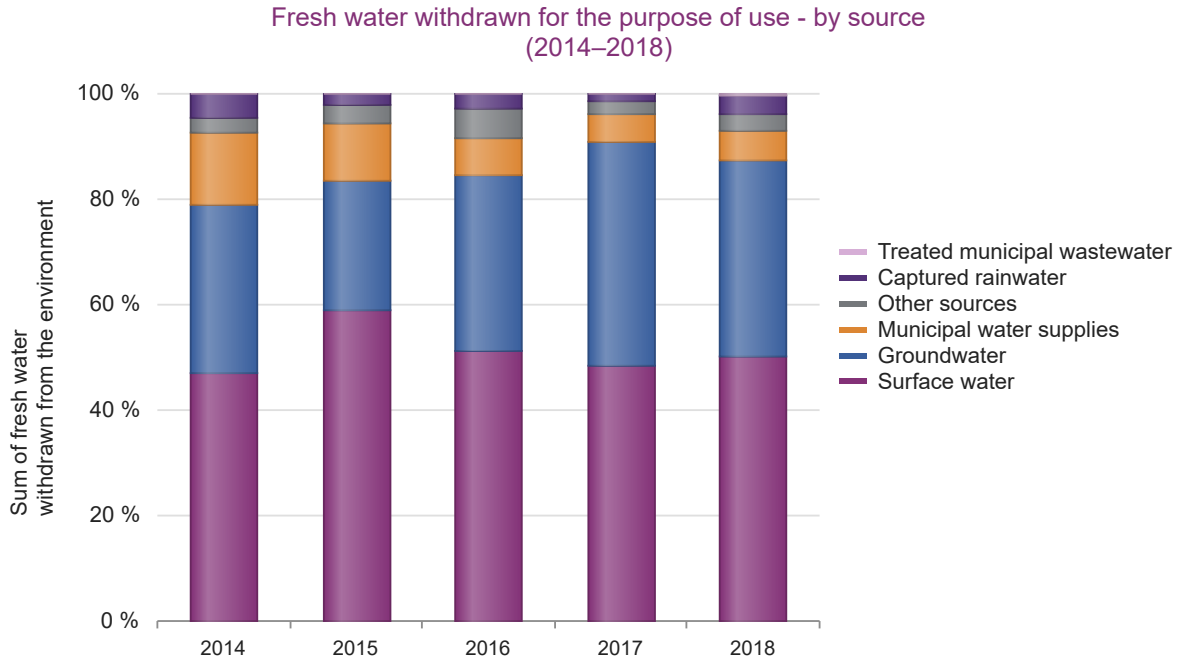
In 2018, regional averages for quantity of fresh water withdrawn for the purpose of use expressed per unit of production varied from 4.1 to 488.2 cubic metres per thousand tonnes of hydrocarbon production. The increase in 2017 in the Russia & Central Asia region is attributable to the introduction of new data.

Figure 48:



28 of the 37 companies that provided water withdrawal data in 2018 provided data broken down by source (33 in 2017, 23 in 2016, 15 in 2015 and 14 in 2014). This represents 90% of the total reported fresh water withdrawn in 2018 (82% in 2017, 77% in 2016, 93% in 2015 and 89% in 2014). See Figure 49.

Figure 49:



Appendix A: Data tables

Scope of data submissions

Table A.1: Production associated with IOGP database and 2018 production in BP Statistical Review of World Energy 2019 - by region (Figures 3 and 4)

Year	Region	Production in this report (Mt)	Production in BP Statistical Review of world Energy (Mt)	Production as % of production in BP Statistical Review of World Energy
2018	Africa	349	592	59%
2018	Asia / Australasia	304	905	34%
2018	Europe	316	378	83%
2018	Middle East	464	2,081	22%
2018	North America	301	1,933	16%
2018	Russia & Central Asia	143	1,424	10%
2018	South & Central America	254	487	52%
2018	SUM TOTAL	2,131	7,800	27%
2017	Africa	328	577	57%
2017	Asia / Australasia	291	898	32%
2017	Europe	305	371	82%
2017	Middle East	451	2,049	22%
2017	North America	307	1,735	18%
2017	Russia & Central Asia	134	1,401	10%
2017	South & Central America	256	522	49%
2017	SUM TOTAL	2,073	7,552	27%
2016	Africa	304	562	54%
2016	Asia / Australasia	294	905	32%
2016	Europe	315	383	82%
2016	Middle East	472	2,071	23%
2016	North America	298	1,753	17%
2016	Russia & Central Asia	106	1,378	8%
2016	South & Central America	243	544	45%
2016	SUM TOTAL	2,032	7,595	27%

Production (Mt) = Million tonnes hydrocarbon production

NB: Production figures given in this report relate to 'gross production' whereas world data extracted from the BP Statistical Review of World Energy represent 'net production'. Thus the data are not directly comparable, but the 'percentage of world production' figures are given as indicative of the relative regional contributions in the database.

Detailed review

Gaseous emissions

Table A.2: Emissions per unit of hydrocarbon production

	CO2		CH4		NMVOC		SO2		NOX		GHG*
Year	t/1000t	Prod'n Mt	t/1000t	Prod'n Mt	t/1000t	Prod'n Mt	t/1000t	Prod'n Mt	t/1000t	Prod'n Mt	t/1000t
2018	129	2,127	0.73	2,082	0.40	2,005	0.21	2,114	0.33	2,125	148
2017	133	2,061	0.75	1,989	0.44	1,902	0.20	1,990	0.37	1,999	151
2016	129	2,028	0.89	1,984	0.43	1,922	0.18	1,986	0.35	1,986	151
2015	129	2,124	0.87	2,077	0.42	2,009	0.20	2,077	0.38	2,080	151
2014	134	2,081	0.91	2,033	0.50	1,930	0.19	1,994	0.44	2,030	157

Prod'n Mt = Million tonnes hydrocarbon production, t/1000t = tonnes per thousand tonnes

NB: Data only included where gas quantity and production level are both reported.

Table A.3: Gross emissions of gasses by region

		Million tonnes		Thousand tonnes			
Year	Region	CO2	GHG*	CH4	NMVOC	SO2	NOX
2018	Africa	59.02	67.76	349.68	138.66	18.61	135.44
2018	Asia / Australasia	58.44	65.40	278.56	100.76	13.70	112.69
2018	Europe	27.22	29.98	110.65	64.41	6.89	88.46
2018	Middle East	29.94	31.22	51.05	95.80	334.08	77.92
2018	North America	59.99	70.75	430.28	159.98	30.91	157.70
2018	Russia & Central Asia	14.17	18.44	170.96	13.09	25.93	30.21
2018	South & Central America	28.11	31.63	140.80	228.07	16.09	121.75
2018	OVERALL (All regions)	276.88	315.18	1,531.98	800.78	446.21	724.16

Table A.4: Emissions per unit of production

Region	Emissions	Tonnes per thousand tonnes			Million tonnes production**		
		2018	2017	2016	2018	2017	2016
Africa	CO2	169.73	182.60	205.78	347	324	300
Africa	CH4	1.01	0.96	1.09	347	324	300
Africa	NMVOC	0.41	0.46	0.53	338	315	295
Africa	SO2	0.05	0.04	0.05	338	315	295
Africa	NOX	0.38	0.39	0.44	347	324	295
Africa	GHG	194.98	206.60	233.03			
Asia / Australasia	CO2	192.27	183.86	173.70	304	291	294
Asia / Australasia	CH4	1.07	1.24	1.40	260	247	249
Asia / Australasia	NMVOC	0.39	0.73	0.49	258	244	247
Asia / Australasia	SO2	0.05	0.04	0.07	302	289	291
Asia / Australasia	NOX	0.37	0.44	0.42	302	289	291
Asia / Australasia	GHG	219.02	214.86	208.70			
Europe	CO2	83.64	83.28	87.80	325	305	315
Europe	CH4	0.34	0.36	0.42	325	305	315
Europe	NMVOC	0.20	0.24	0.26	325	305	315
Europe	SO2	0.02	0.02	0.02	325	305	315
Europe	NOX	0.27	0.32	0.35	325	305	315
Europe	GHG	92.14	92.28	98.30			
Middle East	CO2	64.47	68.93	48.41	464	449	472
Middle East	CH4	0.11	0.12	0.10	464	449	472
Middle East	NMVOC	0.22	0.27	0.30	442	429	452
Middle East	SO2	0.72	0.62	0.50	462	449	472
Middle East	NOX	0.17	0.16	0.11	464	449	472
Middle East	GHG	67.22	71.93	50.91			
North America	CO2	198.85	204.32	201.42	301	307	298
North America	CH4	1.43	1.67	2.41	301	282	298
North America	NMVOC	0.53	0.45	0.55	301	282	298
North America	SO2	0.10	0.12	0.15	301	282	298
North America	NOX	0.52	0.58	0.56	301	282	298
North America	GHG	234.60	246.07	261.67			
Russia & Central Asia	CO2	96.64	101.84	99.19	143	128	106
Russia & Central Asia	CH4	1.19	0.61	0.38	143	128	106
Russia & Central Asia	NMVOC	0.08	0.09	0.08	120	105	106
Russia & Central Asia	SO2	0.18	0.23	0.18	143	128	106
Russia & Central Asia	NOX	0.20	0.24	0.22	143	128	106
Russia & Central Asia	GHG	126.39	117.09	108.69			
South & Central America	CO2	110.26	111.21	112.00	252	256	243
South & Central America	CH4	0.56	0.57	0.64	252	253	243
South & Central America	NMVOC	0.99	0.86	0.72	231	221	209
South & Central America	SO2	0.06	0.07	0.08	252	221	209
South & Central America	NOX	0.47	0.58	0.43	252	221	209
South & Central America	GHG	124.26	125.46	128.00			

NB: Data only included where gas quantity and production level are both reported.

Table A.5: Emissions by source

Year	Source	Million tonnes		Thousand tonnes		
		CO2	GHG*	CH4	NMVOC	NOX
2018	Energy/Fuel combustion	128.02	130.18	86.42	27.61	422.24
2018	Flare	42.27	48.08	232.74	107.48	21.64
2018	Process vents	9.47	26.63	686.24	380.66	0.77
2018	Fugitive losses	0.05	5.01	198.55	70.84	0.02
2018	Other/Unspecified E&P	96.48	104.63	326.08	212.91	277.18
2018	SUM TOTAL	276.28	314.53	1,530.03	799.49	721.85
2017	Energy/Fuel combustion	123.55	125.70	85.97	19.37	439.64
2017	Flare	44.11	48.77	186.23	103.22	19.52
2017	Process vents	11.50	26.05	581.89	262.05	0.03
2017	Fugitive losses	1.53	7.58	241.90	109.42	2.87
2017	Other/Unspecified E&P	93.68	103.70	400.69	343.34	297.55
2017	SUM TOTAL	274.37	311.78	1,496.68	837.39	759.61
2016	Energy/Fuel combustion	113.61	115.55	77.46	52.46	393.00
2016	Flare	42.57	47.53	198.75	106.62	20.94
2016	Process vents	9.67	24.49	592.90	208.37	0.23
2016	Fugitive losses	0.04	6.13	243.28	91.64	0.01
2016	Other/Unspecified E&P	96.34	112.81	658.74	362.56	295.25
2016	SUM TOTAL	262.23	306.51	1,771.13	821.65	709.43

Table A.6: Gas emissions in production activities per unit of hydrocarbon production – onshore and offshore

Year	Location	CO2		CH4		NMVOC		SO2		NOX		GHG*
		t/1000t	Prod'n Mt	t/1000t	Prod'n Mt	t/1000t	Prod'n Mt	t/1000t	Prod'n Mt	t/1000t	Prod'n Mt	t/1000t
2018	Onshore	133	870	0.88	870	0.38	803	0.41	867	0.30	869	149
2018	Offshore	115	1,073	0.62	1,028	0.44	1,019	0.08	1,064	0.35	1,072	131
2017	Onshore	140	832	0.90	828	0.37	749	0.37	794	0.36	794	158
2017	Offshore	116	1,039	0.63	996	0.44	987	0.09	1,030	0.37	1,039	134
2016	Onshore	131	854	1.15	854	0.52	799	0.33	817	0.35	817	160
2016	Offshore	120	1,038	0.67	994	0.35	987	0.08	1,033	0.36	1,033	149
2015	Onshore	135	910	1.16	910	0.52	847	0.33	872	0.39	872	150
2015	Offshore	122	1,039	0.58	993	0.34	987	0.12	1,030	0.37	1,033	137
2014	Onshore	151	842	1.33	838	0.63	761	0.33	782	0.47	807	171
2014	Offshore	121	1,043	0.57	1,000	0.44	973	0.10	1,017	0.43	1,028	141

Prod'n Mt = Million tonnes hydrocarbon production, t/1000t = tonnes per thousand tonnes

NB: Data only included where gas quantity and production level are both reported.

**GHG: Total greenhouse gases (CO2 + CH4 expressed in CO2 equivalent: GHG = CO2 + (25 x CH4))*
***"Production for [gas] normalization (Mt)" = production included in calculation of [gas] per unit of production (million tonnes)*

Energy consumption

Table A.7: Energy consumed per unit of hydrocarbon production (Figure 25)

Year	Percent			Total energy consumption (Gigajoules per tonne)	Production (Mt)
	Onsite combustion	Purchased	Unspecified		
2018	78%	7%	15%	1.48	2,118
2017	78%	6%	15%	1.45	1,883
2016	77%	8%	15%	1.44	2,030
2015	77%	8%	15%	1.43	2,124

Production (Mt) = Million tonnes hydrocarbon production

NB: Data only included where energy and production level are both reported.

Production is the total hydrocarbon production for data sets where one of onsite, purchased or unspecified energy is reported.

Table A.8: Gross energy consumption – by region

Year	Region	Million Gigajoules			
		Onsite combustion	Purchased	Unspecified	Total
2018	Africa	404	5	94	504
2018	Asia / Australasia	329	23	183	535
2018	Europe	365	41	6	411
2018	Middle East	118	81	4	203
2018	North America	780	60	105	945
2018	Russia & Central Asia	145	9	55	209
2018	South & Central America	318	6	11	334
2018	OVERALL (Sum of regions)	2,458	226	457	3,142
2017	Africa	391	4	88	484
2017	Asia / Australasia	321	23	159	503
2017	Europe	347	39	8	393
2017	Middle East	104	50	5	159
2017	North America	776	47	98	921
2017	Russia & Central Asia	118	13	49	181
2017	South & Central America	95	0	10	105
2017	OVERALL (Sum of regions)	2,152	176	417	2,746
2016	Africa	378	20	85	482
2016	Asia / Australasia	346	24	133	502
2016	Europe	360	42	6	408
2016	Middle East	87	46	12	145
2016	North America	770	82	143	994
2016	Russia & Central Asia	91	1	52	144
2016	South & Central America	235	18	11	263
2016	OVERALL (Sum of regions)	2,267	231	440	2,938

Table A.9: Energy consumption per unit of hydrocarbon production – by region (Figure 26)

Year	Region	Percent			Total energy consumption (Gigajoules per tonne)	Production (Mt)
		Onsite combustion	Purchased	Unspecified		
2018	Africa	80%	1%	19%	1.45	347
2018	Asia / Australasia	62%	4%	34%	1.77	302
2018	Europe	89%	10%	1%	1.30	316
2018	Middle East	58%	40%	2%	0.44	462
2018	North America	83%	6%	11%	3.15	300
2018	Russia & Central Asia	68%	4%	27%	1.42	143
2018	South & Central America	96%	2%	3%	1.33	248
2018	OVERALL (All regions)	78%	7%	15%	1.48	2,118
2017	Africa	81%	1%	18%	1.48	324
2017	Asia / Australasia	64%	5%	32%	1.73	290
2017	Europe	88%	10%	2%	1.29	305
2017	Middle East	65%	32%	3%	0.35	451
2017	North America	84%	5%	11%	3.28	281
2017	Russia & Central Asia	65%	8%	28%	1.32	134
2017	South & Central America	90%	0%	10%	1.07	98
2017	OVERALL (All regions)	78%	6%	15%	1.45	1,883
2016	Africa	78%	4%	18%	1.58	304
2016	Asia / Australasia	69%	5%	27%	1.71	293
2016	Europe	88%	10%	1%	1.30	315
2016	Middle East	60%	32%	8%	0.30	472
2016	North America	77%	8%	14%	3.35	297
2016	Russia & Central Asia	62%	1%	37%	1.31	106
2016	South & Central America	89%	7%	4%	1.08	243
2016	OVERALL (All regions)	77%	8%	15%	1.44	2,030

Production (Mt) = Million tonnes hydrocarbon production

NB: Data only included where energy and production level are both reported.

Production is the total hydrocarbon production for data sets where one of onsite, purchased or unspecified energy is reported.

Table A.10: Energy consumption per unit of hydrocarbon production – onshore and offshore

Year	Location	Percent			Total energy consumption (Gigajoules per tonne)	Production (Mt)
		Onsite combustion	Purchased	Unspecified		
2018	Onshore (All regions)	74%	13%	13%	1.65	862
2018	Offshore (All regions)	90%	2%	8%	1.27	1,072
2018	Unspecified (All regions)	49%	4%	47%	1.86	183
2018	OVERALL (All regions)	78%	7%	15%	1.48	2,118
2017	Onshore (All regions)	74%	10%	16%	1.71	819
2017	Offshore (All regions)	88%	2%	10%	1.21	899
2017	Unspecified (All regions)	63%	6%	31%	1.53	165
2017	OVERALL (All regions)	78%	6%	15%	1.45	1,883
2016	Onshore (All regions)	69%	11%	19%	1.74	856
2016	Offshore (All regions)	87%	4%	9%	1.19	1,038
2016	Unspecified (All regions)	74%	9%	18%	1.50	136
2016	OVERALL (All regions)	77%	8%	15%	1.44	2,030

Production (Mt) = Million tonnes hydrocarbon production

NB: Data only included where energy and production level are both reported.

Production is the total hydrocarbon production for data sets where one of onsite, purchased or unspecified energy is reported.

Flaring

Table A.11: Hydrocarbon flared per unit of production (Figure 27)

Year	Total flared (t/1000t)	Production (Mt)
2018	10.50	2,134
2017	12.07	2,057
2016	12.94	2,028
2015	13.61	2,097
2014	14.84	2,076

Production (Mt) = Million tonnes hydrocarbon production, t/1000t = Tonnes per thousand tonnes

NB: Data only included where flaring and production level are both reported.

Production is the total hydrocarbon production for data sets where flaring is reported.

Table A.12: Flaring per unit of hydrocarbon production – by region (Figure 28)

Year	Region	Total flared (t/1000t)	Production (Mt)
2018	Africa	29.55	347
2018	Asia / Australasia	14.34	304
2018	Europe	3.32	325
2018	Middle East	4.14	464
2018	North America	7.92	301
2018	Russia & Central Asia	5.84	143
2018	South & Central America	6.30	251
2018	OVERALL (All Regions)	10.50	2,134
2017	Africa	35.64	324
2017	Asia / Australasia	19.56	288
2017	Europe	2.87	305
2017	Middle East	5.03	451
2017	North America	6.48	307
2017	Russia & Central Asia	7.78	128
2017	South & Central America	5.98	253
2017	OVERALL (All Regions)	12.07	2,057
2016	Africa	41.00	301
2016	Asia / Australasia	22.48	294
2016	Europe	3.60	315
2016	Middle East	3.34	472
2016	North America	6.95	298
2016	Russia & Central Asia	7.03	106
2016	South & Central America	7.42	243
2016	OVERALL (All Regions)	12.94	2,028

Production (Mt) = Million tonnes hydrocarbon production, t/1000t = Tonnes per thousand tonnes

NB: Data only included where flaring and production level are both reported.

Production is the total hydrocarbon production for data sets where flaring is reported.

Produced water

Table A.13: Oil discharged per unit of produced water discharged (Figure 29)

	Milligrammes oil per litre of produced water discharged				
	2014	2015	2016	2017	2018
Onshore	10.26	8.46	5.84	3.89	5.22
Offshore	12.88	13.48	12.32	17.88	18.33
Unspecified	5.04	5.80	12.31	10.82	5.75
OVERALL	12.31	12.70	11.43	15.20	16.07

NB: Data only included where oil in produced water and produced water quantity are both reported.

Table A.14: Oil content of produced water discharged (Figures 30 and 31)

		Oil discharged (t/Mt)				Produced water (Mt)			
Year	Region	Onshore	Offshore	Unspecified	OVERALL	Onshore	Offshore	Unspecified	OVERALL
2018	Africa	18.64	16.26	5.99	14.58	10.73	109.31	26.54	146.57
2017	Africa	16.84	22.59	11.19	19.82	6	96.43	28.79	131.21
2016	Africa	7.73	15.39	13	13.98	16.51	96.05	31.8	144.37
2018	Asia / Australasia	8.27	13	35.96	12.85	8.1	239.39	0.03	247.52
2017	Asia / Australasia	4.39	13.27	0	12.01	54.72	330.35	0.02	385.09
2016	Asia / Australasia	2.23	12.28	no data	10.13	98.23	360.2	no data	458.43
2018	Europe	0	11.39	0.55	11.17	2.6	196.67	1.34	200.62
2017	Europe	0	11.78	1.85	11.56	2.46	178.38	1.09	181.93
2016	Europe	0.1	11.85	0.31	11.67	1.67	226.77	1.92	230.36
2018	Middle East	2.64	6.44	no data	2.99	94.94	9.44	no data	104.38
2017	Middle East	2.03	8.17	no data	2.22	102.4	3.42	no data	105.81
2016	Middle East	0	6.71	no data	6.64	0.03	3.05	no data	3.09
2018	North America	15.23	15.14	no data	15.15	3.35	22.2	no data	25.55
2017	North America	14.42	13.65	no data	13.75	4.3	30.27	no data	34.57
2016	North America	19.31	12.07	0	14.75	22.32	37.71	0.03	60.06
2018	OVERALL (All regions)	5.22	18.33	5.75	16.07	121.64	712.41	27.93	861.98
2017	OVERALL (All regions)	3.89	17.88	10.82	15.2	172.22	773.73	29.93	975.88
2016	OVERALL (All regions)	5.84	12.32	12.31	11.43	142.26	852.71	33.79	1028.76
2018	Russia & Central Asia	no data	45.73	no data	45.73	no data	0.02	no data	0.02
2017	Russia & Central Asia	no data	25.06	no data	25.06	no data	0.08	no data	0.08
2016	Russia & Central Asia	no data	41.13	no data	41.13	no data	0.41	no data	0.41
2018	South & Central America	34.68	40.83	0	40.74	1.92	135.37	0.03	137.32
2017	South & Central America	25.66	35.1	0	34.93	2.34	134.81	0.04	137.19
2016	South & Central America	15.27	11.08	48.97	11.21	3.48	128.52	0.04	132.04

NB: Data only included where oil discharges and produced water discharges are both reported

Table A.15: Oil discharged per unit of hydrocarbon production (Figure 32)

	Tonnes per million tonnes				
	2014	2015	2016	2017	2018
Onshore	2.04	1.36	1.38	0.86	0.77
Offshore	11.53	10.99	10.15	13.33	12.32
Unspecified	1.31	1.43	3.12	1.99	0.90
OVERALL	7.49	6.90	6.63	7.48	6.70

NB: Data only included where oil discharges and produced water discharges are both reported.

Table A.16: Oil discharged per unit of hydrocarbon production – by region (Figures 33, 34)

Year	Region	Oil discharged (t/Mt)				Produced water (Mt)			
		Onshore	Offshore	Unspecified	OVERALL	Onshore	Offshore	Unspecified	OVERALL
2018	Africa	2.86	10.3	1.53	6.16	70	172	104	346
2017	Africa	2.45	12.07	3.25	8.11	41	180	99	320
2016	Africa	3.44	8.36	4.78	6.72	37	176	86	300
2018	Asia / Australasia	0.91	18	0.02	10.97	73	172	43	289
2017	Asia / Australasia	3.16	23.32	0	15.96	76	188	25	289
2016	Asia / Australasia	2.37	22.78	0	15.97	92	194	3	290
2018	Europe	0	8.67	0.02	7.32	17	258	30	306
2017	Europe	0	8.7	0.06	7.14	17	241	35	294
2016	Europe	0.01	10.89	0.02	8.84	18	246	39	304
2018	Middle East	0.81	0.48	no data	0.71	315	126	no data	441
2017	Middle East	0.67	0.23	no data	0.55	307	121	no data	428
2016	Middle East	0	0.16	no data	0.07	171	124	no data	296
2018	North America	0.24	4.32	no data	1.32	215	77	no data	293
2017	North America	0.31	5.89	no data	1.77	197	70	no data	267
2016	North America	2.58	6.62	no data	3.75	167	68	no data	236
2018	OVERALL (All regions)	0.77	12.32	0.9	6.7	831	1,059	178	2,069
2017	OVERALL (All regions)	0.86	13.33	1.99	7.48	781	1,038	162	1,983
2016	OVERALL (All regions)	1.38	10.15	3.12	6.63	604	1,035	133	1,773
2018	Russia & Central Asia	0	0.02	no data	0.01	78	64	no data	143
2017	Russia & Central Asia	0	0.04	no data	0.02	77	51	no data	128
2016	Russia & Central Asia	0	0.32	no data	0.16	51	53	no data	105
2018	South & Central America	1.08	29.66	no data	22.55	61	186	no data	248
2017	South & Central America	0.93	25.45	0	18.94	64	186	2	253
2016	South & Central America	0.81	8.4	0.53	6.19	65	170	3	239

NB: Data only included where oil discharges and produced water discharges are both reported

Table A.17: Percent of produced water re-injected overall (expressed as percent total produced water generated*) (Figure 35)

	Percent of produced water re-injected				
	2018	2017	2016	2015	2014
Onshore	86%	86%	72%	85%	82%
Offshore	32%	27%	25%	26%	27%
Unspecified	45%	86%	81%	45%	46%
OVERALL	58%	59%	46%	55%	53%

** Total produced water generated: produced water discharged + produced water re-injected.*

Table A.18: Percent of produced water re-injected (expressed as percent total produced water generated*) – by region

		Percent of produced water re-injected (expressed as percent total produced water generated*)				Overall gross produced water (Mt)	
Year	Region	Onshore	Offshore	Unspecified	OVERALL	Discharged	Reinjected
2018	Africa	68%	33%	42%	41%	117	80
2018	Asia / Australasia	50%	34%	97%	34%	231	122
2018	Europe	96%	26%	71%	40%	201	134
2018	Middle East	54%	85%	no data	61%	104	165
2018	North America	98%	7%	no data	89%	24	194
2018	Russia & Central Asia	100%	100%	no data	100%	0	139
2018	South & Central America	99%	13%	0%	66%	137	272
2018	OVERALL (All regions)	86%	32%	45%	58%	814	1,107
2017	Africa	74%	48%	53%	54%	68	80
2017	Asia / Australasia	43%	21%	100%	23%	315	93
2017	Europe	96%	26%	73%	40%	169	114
2017	Middle East	51%	92%	no data	58%	106	148
2017	North America	100%	7%	100%	95%	18	321
2017	Russia & Central Asia	100%	99%	no data	100%	0	133
2017	South & Central America	99%	13%	no data	67%	136	274
2017	OVERALL (All regions)	86%	27%	86%	59%	811	1,163
2016	Africa	29%	43%	47%	42%	80	57
2016	Asia / Australasia	16%	17%	no data	17%	381	79
2016	Europe	97%	24%	31%	37%	213	125
2016	Middle East	54%	94%	no data	63%	86	143
2016	North America	80%	5%	100%	80%	34	136
2016	Russia & Central Asia	100%	94%	no data	95%	0	8
2016	South & Central America	98%	13%	no data	65%	131	239
2016	OVERALL (All regions)	72%	25%	81%	46%	925	787

** Total produced water generated: produced water discharged + produced water re-injected.*

Table A.19: Produced water re-injected per unit of hydrocarbon production – by region

		Produced water re-injected (t/t)				Production (Mt)			
Year	Region	Onshore	Offshore	Unspecified	OVERALL	Onshore	Offshore	Unspecified	OVERALL
2018	Africa	0.33	0.32	0.18	0.27	68	122	104	294
2018	Asia / Australasia	0.13	0.73	0.02	0.47	63	155	43	262
2018	Europe	5.14	0.27	0.21	0.5	15	258	33	306
2018	Middle East	0.34	0.42	no data	0.36	335	127	no data	462
2018	North America	1.26	0.02	no data	0.87	152	71	no data	223
2018	Russia & Central Asia	1.64	0.21	no data	1.08	78	51	no data	129
2018	South & Central America	3.97	0.11	no data	1.12	65	184	no data	249
2018	OVERALL (All regions)	1.03	0.32	0.15	0.59	777	967	180	1,924
2017	Africa	0.53	0.37	0.26	0.36	43	105	72	221
2017	Asia / Australasia	0.23	0.6	0.5	0.52	38	139	4	181
2017	Europe	4.87	0.25	0.17	0.49	15	234	38	288
2017	Middle East	0.33	0.34	no data	0.33	327	121	no data	448
2017	North America	2.17	0.03	3.46	1.82	121	47	25	193
2017	Russia & Central Asia	3.52	0.2	no data	1.78	36	39	no data	75
2017	South & Central America	3.87	0.11	no data	1.12	67	182	no data	248
2017	OVERALL (All regions)	1.33	0.29	0.82	0.74	647	867	140	1,654
2016	Africa	0.18	0.31	0.27	0.27	38	105	63	207
2016	Asia / Australasia	0.25	0.49	no data	0.43	44	141	no data	185
2016	Europe	3.57	0.28	0.11	0.48	20	237	42	300
2016	Middle East	0.28	0.38	no data	0.31	346	125	no data	470
2016	North America	1.15	0.02	no data	0.78	94	46	no data	140
2016	Russia & Central Asia	0.1	0.16	no data	0.15	12	42	no data	54
2016	South & Central America	3.42	0.12	no data	1.08	68	166	no data	234
2016	OVERALL (All regions)	0.85	0.28	0.21	0.5	623	862	105	1,590

Table A.20: Total oil discharged (discharges + spills) per unit of hydrocarbon production

Year	Location	discharged per unit production (t/Mt)	Hydrocarbon production (Mt)
2018	Onshore	6	831
2018	Offshore	13	1,029
2018	Unspecified	2	178
2018	OVERALL	9	2,038
2017	Onshore	5	755
2017	Offshore	14	1,032
2017	Unspecified	6	163
2017	OVERALL	10	1,950
2016	Onshore	5	597
2016	Offshore	11	1,033
2016	Unspecified	4	133
2016	OVERALL	8	1,764

Non-aqueous drilling fluids retained on cuttings discharged to sea

Table A.21: Total base fluid (NABF) retained on cuttings discharged to sea (tonnes) – by region (Figure 37)

		Tonnes				
Year	Region	Group I	Group II	Group III	Unspecified	SUM TOTAL
2018	Africa	0	222	97	0	319
2018	Asia / Australasia	0	0	1,207	0	1,207
2018	Europe	0	7	0	0	7
2018	Russia & Central Asia	0	0	0	0	0
2018	Middle East	0	0	0	0	0
2018	North America	0	119	2,232	0	2,351
2018	South & Central America	0	18	1,227	194	1,439
2018	OVERALL (All regions)	0	366	4,763	194	5,323
2017	Africa	0	75	182	0	257
2017	Asia / Australasia	0	357	3,151	0	3,508
2017	Europe	0	4	2,223	0	2,227
2017	Russia & Central Asia	0	0	23	0	23
2017	Middle East	0	0	0	0	0
2017	North America	0	0	859	0	859
2017	South & Central America	0	0	2,026	0	2,026
2017	OVERALL (All regions)	0	436	8,464	0	8,900
2016	Africa	0	134	328	0	462
2016	Asia / Australasia	0	182	5,043	0	5,225
2016	Europe	0	4	89	17	110
2016	Russia & Central Asia	0	0	96	0	96
2016	Middle East	0	0	0	0	0
2016	North America	0	0	600	0	600
2016	South & Central America	0	73	10,249	0	10,322
2016	OVERALL (All regions)	0	393	16,405	17	16,815

NB: Data only included where oil in produced water and produced water quantity are both reported.

Spills

Table A.22: Number of oil spills >1 barrel in size and quantity spilled per unit of hydrocarbon production (Figures 38, 40)

Year	Location	Number of spills per million tonnes	Quantity spilled (tonnes/million tonnes)	Production (million tonnes)
2018	Onshore	1.12	5.26	870
2018	Offshore	0.09	0.40	1,028
2018	Unspecified	0.27	1.14	180
2018	OVERALL	0.54	2.50	2,079
2017	Onshore	0.90	4.04	788
2017	Offshore	0.09	0.24	1,032
2017	Unspecified	1.08	17.49	188
2017	OVERALL	0.50	3.34	2,007
2016	Onshore	0.80	3.02	850
2016	Offshore	0.09	0.49	1,035
2016	Unspecified	0.49	1.11	136
2016	OVERALL	0.41	1.60	2,021
2015	Onshore	1.54	8.43	890
2015	Offshore	0.09	0.32	1,023
2015	Unspecified	0.25	0.79	174
2015	OVERALL	0.72	3.82	2,087
2014	Onshore	1.91	7.65	796
2014	Offshore	0.13	0.37	1,009
2014	Unspecified	0.42	0.84	144
2014	OVERALL	0.88	3.38	1,948

NB: Data only included where quantity of oil spilt and production level are both reported.

Excludes spills <1 barrel in size.

Table A.23: Number of oil spills >1 barrel in size and quantity spilled per unit of hydrocarbon production – by region (Figures 39, 40, 41)

Year	Region	Location	Number of spills per million tonnes	Quantity spilled (tonnes/million tonnes)	Production (million tonnes)
2018	Africa	Onshore	2.17	29.95	70
2018	Africa	Offshore	0.11	0.21	174
2018	Africa	Unspecified	0.39	1.90	104
2018	Africa	OVERALL	0.61	6.69	349
2018	Asia / Australasia	Onshore	0.23	1.03	74
2018	Asia / Australasia	Offshore	0.21	0.53	173
2018	Asia / Australasia	Unspecified	0.05	0.01	43
2018	Asia / Australasia	OVERALL	0.19	0.58	290
2018	Europe	Onshore	2.44	1.93	24
2018	Europe	Offshore	0.10	0.24	256
2018	Europe	Unspecified	0.15	0.23	33
2018	Europe	OVERALL	0.29	0.37	313
2018	Middle East	Onshore	0.20	0.93	335
2018	Middle East	Offshore	0.00	0.00	127
2018	Middle East	OVERALL	0.15	0.67	462
2018	North America	Onshore	2.18	5.79	224
2018	North America	Offshore	0.11	3.72	57
2018	North America	OVERALL	1.76	5.37	281
2018	Russia & Central Asia	Onshore	1.64	8.58	78
2018	Russia & Central Asia	Offshore	0.00	0.00	55
2018	Russia & Central Asia	OVERALL	0.96	5.03	133
2018	South & Central America	Onshore	0.95	1.26	65
2018	South & Central America	Offshore	0.04	0.03	187
2018	South & Central America	OVERALL	0.28	0.35	252
2017	Africa	Onshore	2.07	39.99	45
2017	Africa	Offshore	0.12	0.72	180
2017	Africa	Unspecified	0.29	3.14	99
2017	Africa	OVERALL	0.44	6.89	324
2017	Asia / Australasia	Onshore	0.18	0.05	78
2017	Asia / Australasia	Offshore	0.09	0.08	188
2017	Asia / Australasia	Unspecified	0.12	0.06	26
2017	Asia / Australasia	OVERALL	0.12	0.07	291
2017	Europe	Onshore	2.88	1.19	26
2017	Europe	Offshore	0.15	0.32	241
2017	Europe	Unspecified	0.11	9.36	35
2017	Europe	OVERALL	0.38	1.46	302
2017	Middle East	Onshore	0.22	0.89	309
2017	Middle East	Offshore	0.01	0.01	121
2017	Middle East	OVERALL	0.16	0.64	431
2017	North America	Onshore	1.77	4.68	212
2017	North America	Offshore	0.12	0.13	64
2017	North America	Unspecified	6.68	105.67	25
2017	North America	OVERALL	1.83	12.09	301
2017	Russia & Central Asia	Onshore	0.11	0.20	54
2017	Russia & Central Asia	Offshore	0.02	0.03	51
2017	Russia & Central Asia	OVERALL	0.07	0.11	105

Year	Region	Location	Number of spills per million tonnes	Quantity spilled (tonnes/million tonnes)	Production (million tonnes)
2017	South & Central America	Onshore	1.22	1.23	64
2017	South & Central America	Offshore	0.06	0.06	186
2017	South & Central America	Unspecified	0.00	0.00	3
2017	South & Central America	OVERALL	0.35	0.35	253
2016	Africa	Onshore	1.98	22.19	41
2016	Africa	Offshore	0.14	0.35	177
2016	Africa	Unspecified	0.73	1.73	86
2016	Africa	OVERALL	0.55	3.68	304
2016	Asia / Australasia	Onshore	0.17	0.33	95
2016	Asia / Australasia	Offshore	0.06	0.03	193
2016	Asia / Australasia	Unspecified	1.01	0.26	4
2016	Asia / Australasia	OVERALL	0.11	0.13	292
2016	Europe	Onshore	2.80	3.13	25
2016	Europe	Offshore	0.13	0.53	247
2016	Europe	Unspecified	0.00	0.00	42
2016	Europe	OVERALL	0.33	0.67	315
2016	Middle East	Onshore	0.19	0.86	346
2016	Middle East	Offshore	0.02	0.01	125
2016	Middle East	OVERALL	0.15	0.63	471
2016	North America	Onshore	1.50	4.22	229
2016	North America	Offshore	0.12	4.26	69
2016	North America	OVERALL	1.18	4.23	298
2016	Russia & Central Asia	Onshore	0.19	0.15	53
2016	Russia & Central Asia	Offshore	0.04	0.21	54
2016	Russia & Central Asia	OVERALL	0.11	0.18	106
2016	South & Central America	Onshore	1.42	4.57	62
2016	South & Central America	Offshore	0.06	0.03	170
2016	South & Central America	Unspecified	0.00	0.00	4
2016	South & Central America	OVERALL	0.42	1.22	236

NB: Data only included for production level where oil quantities spilled and production are reported. If no spill count (including zeros) is provided, the data are excluded from the analysis. This analysis could yield inflated values of spill intensity as some reporters may not report zeros for datasets where no spill occurred. Excludes spills <1 barrel in size.

Table A.24: Quantity of oil spilled per spill onshore and offshore (tonnes) – by region

Year	Location	Average size (tonnes)	Quantity spilled (tonnes)
2018	Onshore	4.7	4,585
2018	Offshore	4.1	414
2018	Unspecified	4.3	206
2018	OVERALL	4.6	5,205
2017	Onshore	4.5	3,184
2017	Offshore	2.5	245
2017	Unspecified	16.2	3,285
2017	OVERALL	6.7	6,713
2016	Onshore	3.8	2,578
2016	Offshore	5.9	548
2016	Unspecified	2.2	151
2016	OVERALL	3.9	3,277

NB: Data only included where quantity of oil spilt and production level are both reported.

Excludes spills <1 barrel in size.

Table A.25: Distribution of oil spills onshore and offshore by size (Figures 42, 43)

Year	Location	Size	Number of spills	Quantity spilled (tonnes)
2018	Onshore	<1 barrel	3,737	55
2018	Onshore	1-10 barrel	673	290
2018	Onshore	10-100 barrel	214	882
2018	Onshore	>100 barrel	67	3,386
2018	Onshore	Unspecified (excl. spills <1bbl)	20	28
2018	Onshore	OVERALL	4,711	4,640
2018	Offshore	<1 barrel	2,432	26
2018	Offshore	1-10 barrel	77	31
2018	Offshore	10-100 barrel	21	107
2018	Offshore	>100 barrel	2	276
2018	Offshore	Unspecified (excl. spills <1bbl)	0	0
2018	Offshore	OVERALL	2,532	439
2018	Unspecified	<1 barrel	1	0
2018	Unspecified	1-10 barrel	7	2
2018	Unspecified	10-100 barrel	3	8
2018	Unspecified	>100 barrel	0	0
2018	Unspecified	Unspecified (excl. spills <1bbl)	38	196
2018	Unspecified	OVERALL	49	206
2018	OVERALL	<1 barrel	6,170	81
2018	OVERALL	1-10 barrel	757	323
2018	OVERALL	10-100 barrel	238	996
2018	OVERALL	>100 barrel	69	3,662
2018	OVERALL	Unspecified (excl. spills <1bbl)	58	224
2018	OVERALL	OVERALL	7,292	5,286
2017	Onshore	<1 barrel	4,027	58
2017	Onshore	1-10 barrel	511	221
2017	Onshore	10-100 barrels	151	742
2017	Onshore	>100 barrels	32	2,207
2017	Onshore	Unspecified (excl. spills <1bbl)	16	13
2017	Onshore	OVERALL	4,737	3,242
2017	Offshore	<1 barrel	404	6
2017	Offshore	1-10 barrel	62	27
2017	Offshore	10-100 barrels	28	80
2017	Offshore	>100 barrels	3	137
2017	Offshore	Unspecified (excl. spills <1bbl)	3	0
2017	Offshore	OVERALL	500	251
2017	Unspecified	<1 barrel	246	5
2017	Unspecified	1-10 barrel	132	46
2017	Unspecified	10-100 barrels	25	83
2017	Unspecified	>100 barrels	16	2,773
2017	Unspecified	Unspecified (excl. spills <1bbl)	30	382
2017	Unspecified	OVERALL	449	3,290
2017	OVERALL	<1 barrel	4,677	69
2017	OVERALL	1-10 barrel	705	294
2017	OVERALL	10-100 barrels	204	906
2017	OVERALL	>100 barrels	51	5,118
2017	OVERALL	Unspecified (excl. spills <1bbl)	49	396
2017	OVERALL	OVERALL	5,686	6,782

Year	Location	Size	Number of spills	Quantity spilled (tonnes)
2016	Onshore	<1 barrel	3,276	48
2016	Onshore	1-10 barrel	452	210
2016	Onshore	10-100 barrels	173	666
2016	Onshore	>100 barrels	35	1,667
2016	Onshore	Unspecified (excl. spills <1bbl)	22	35
2016	Onshore	OVERALL	3,958	2,627
2016	Offshore	<1 barrel	446	6
2016	Offshore	1-10 barrel	70	24
2016	Offshore	10-100 barrels	17	78
2016	Offshore	>100 barrels	4	445
2016	Offshore	Unspecified (excl. spills <1bbl)	2	0
2016	Offshore	OVERALL	539	554
2016	Unspecified	<1 barrel	0	0
2016	Unspecified	1-10 barrel	15	7
2016	Unspecified	10-100 barrels	2	9
2016	Unspecified	>100 barrels	1	34
2016	Unspecified	Unspecified (excl. spills <1bbl)	49	102
2016	Unspecified	OVERALL	67	151
2016	OVERALL	<1 barrel	3,722	54
2016	OVERALL	1-10 barrel	537	241
2016	OVERALL	10-100 barrels	192	753
2016	OVERALL	>100 barrels	40	2,146
2016	OVERALL	Unspecified (excl. spills <1bbl)	73	137
2016	OVERALL	OVERALL	4,564	3,331

NB: Overall excludes spills <1 barrel in size.

Table A.26: Distribution of oil spills by size - by region

Year	Region	Size	Number of spills	Quantity spilled (tonnes)
2018	Africa	<1 barrel	20	1
2018	Africa	1-10 barrel	73	33
2018	Africa	10-100 barrel	58	264
2018	Africa	>100 barrel	31	1,836
2018	Africa	Unspecified (excl. spills <1bbl)	51	207
2018	Africa	OVERALL	233	2,341
2018	Asia / Australasia	<1 barrel	2,204	24
2018	Asia / Australasia	1-10 barrel	45	14
2018	Asia / Australasia	10-100 barrel	7	30
2018	Asia / Australasia	>100 barrel	3	124
2018	Asia / Australasia	Unspecified (excl. spills <1bbl)	0	0
2018	Asia / Australasia	OVERALL	2,259	192
2018	Europe	<1 barrel	2,394	28
2018	Europe	1-10 barrel	68	19
2018	Europe	10-100 barrel	15	82
2018	Europe	>100 barrel	0	0
2018	Europe	Unspecified (excl. spills <1bbl)	7	16
2018	Europe	OVERALL	2,484	145
2018	Middle East	<1 barrel	15	1
2018	Middle East	1-10 barrel	56	36
2018	Middle East	10-100 barrel	9	28
2018	Middle East	>100 barrel	3	246
2018	Middle East	Unspecified (excl. spills <1bbl)	0	0
2018	Middle East	OVERALL	83	311
2018	North America	<1 barrel	648	11
2018	North America	1-10 barrel	374	142
2018	North America	10-100 barrel	99	366
2018	North America	>100 barrel	21	1,001
2018	North America	Unspecified (excl. spills <1bbl)	0	0
2018	North America	OVERALL	1,142	1,521
2018	Russia & Central Asia	<1 barrel	99	4
2018	Russia & Central Asia	1-10 barrel	87	56
2018	Russia & Central Asia	10-100 barrel	35	183
2018	Russia & Central Asia	>100 barrel	10	433
2018	Russia & Central Asia	Unspecified (excl. spills <1bbl)	0	0
2018	Russia & Central Asia	OVERALL	231	676
2018	South & Central America	<1 barrel	790	13
2018	South & Central America	1-10 barrel	54	22
2018	South & Central America	10-100 barrel	15	43
2018	South & Central America	>100 barrel	1	22
2018	South & Central America	Unspecified (excl. spills <1bbl)	0	0
2018	South & Central America	OVERALL	860	101
2017	Africa	<1 barrel	88	4
2017	Africa	1-10 barrel	47	26
2017	Africa	10-100 barrels	35	175
2017	Africa	>100 barrels	19	1,966
2017	Africa	Unspecified (excl. spills <1bbl)	43	67
2017	Africa	OVERALL	232	2,238

Year	Region	Size	Number of spills	Quantity spilled (tonnes)
2017	Asia / Australasia	<1 barrel	110	2
2017	Asia / Australasia	1-10 barrel	26	9
2017	Asia / Australasia	10-100 barrels	5	12
2017	Asia / Australasia	>100 barrels	0	0
2017	Asia / Australasia	Unspecified (excl. spills <1bbl)	3	0
2017	Asia / Australasia	OVERALL	144	23
2017	Europe	<1 barrel	2,548	31
2017	Europe	1-10 barrel	92	27
2017	Europe	10-100 barrels	19	41
2017	Europe	>100 barrels	1	43
2017	Europe	Unspecified (excl. spills <1bbl)	3	328
2017	Europe	OVERALL	2,663	470
2017	Middle East	<1 barrel	27	1
2017	Middle East	1-10 barrel	44	27
2017	Middle East	10-100 barrels	20	113
2017	Middle East	>100 barrels	5	135
2017	Middle East	Unspecified (excl. spills <1bbl)	0	0
2017	Middle East	OVERALL	96	276
2017	North America	<1 barrel	1,293	20
2017	North America	1-10 barrel	415	176
2017	North America	10-100 barrels	110	494
2017	North America	>100 barrels	26	2,973
2017	North America	Unspecified (excl. spills <1bbl)	0	0
2017	North America	OVERALL	1,844	3,663
2017	Russia & Central Asia	<1 barrel	55	1
2017	Russia & Central Asia	1-10 barrel	4	2
2017	Russia & Central Asia	10-100 barrels	3	10
2017	Russia & Central Asia	>100 barrels	0	0
2017	Russia & Central Asia	Unspecified (excl. spills <1bbl)	0	0
2017	Russia & Central Asia	OVERALL	62	13
2017	South & Central America	<1 barrel	556	10
2017	South & Central America	1-10 barrel	77	27
2017	South & Central America	10-100 barrels	12	61
2017	South & Central America	>100 barrels	0	0
2017	South & Central America	Unspecified (excl. spills <1bbl)	0	0
2017	South & Central America	OVERALL	645	99
2016	Africa	<1 barrel	94	3
2016	Africa	1-10 barrel	54	22
2016	Africa	10-100 barrels	27	140
2016	Africa	>100 barrels	20	838
2016	Africa	Unspecified (excl. spills <1bbl)	70	124
2016	Africa	OVERALL	265	1,127
2016	Asia / Australasia	<1 barrel	114	2
2016	Asia / Australasia	1-10 barrel	24	10
2016	Asia / Australasia	10-100 barrels	6	15
2016	Asia / Australasia	>100 barrels	0	0
2016	Asia / Australasia	Unspecified (excl. spills <1bbl)	1	13
2016	Asia / Australasia	OVERALL	145	39
2016	Europe	<1 barrel	2,324	26

Year	Region	Size	Number of spills	Quantity spilled (tonnes)
2016	Europe	1-10 barrel	83	31
2016	Europe	10-100 barrels	16	57
2016	Europe	>100 barrels	2	121
2016	Europe	Unspecified (excl. spills <1bbl)	2	0
2016	Europe	OVERALL	2,427	236
2016	Middle East	<1 barrel	16	0
2016	Middle East	1-10 barrel	43	26
2016	Middle East	10-100 barrels	26	90
2016	Middle East	>100 barrels	3	187
2016	Middle East	Unspecified (excl. spills <1bbl)	0	0
2016	Middle East	OVERALL	88	304
2016	North America	<1 barrel	658	12
2016	North America	1-10 barrel	255	114
2016	North America	10-100 barrels	84	330
2016	North America	>100 barrels	13	815
2016	North America	Unspecified (excl. spills <1bbl)	0	0
2016	North America	OVERALL	1,010	1,271
2016	Russia & Central Asia	<1 barrel	209	3
2016	Russia & Central Asia	1-10 barrel	10	6
2016	Russia & Central Asia	10-100 barrels	3	22
2016	Russia & Central Asia	>100 barrels	1	27
2016	Russia & Central Asia	Unspecified (excl. spills <1bbl)	0	0
2016	Russia & Central Asia	OVERALL	223	58
2016	South & Central America	<1 barrel	307	8
2016	South & Central America	1-10 barrel	68	31
2016	South & Central America	10-100 barrels	30	99
2016	South & Central America	>100 barrels	1	159
2016	South & Central America	Unspecified (excl. spills <1bbl)	0	0
2016	South & Central America	OVERALL	406	296

NB: Overall excludes spills <1 barrel in size.

Table A.27: Oil spills > 100 barrels in size (where cause was indicated) – by cause – 2018 (Figure 44)

Cause	Number of spills	Quantity spilled to the environment (tonnes)	Quantity recovered (if reported) (tonnes)
Equipment failure (excluding corrosion)	3	298	298
Corrosion	29	1,171	303
Operator or technical error	3	122	120
Third party damage (sabotage, theft, vandalism, etc)	30	1,527	26
Other	4	544	34
SUM TOTAL	69	3,662	781

NB: Quantity of oil recovered is not reported for all spills.

Table A.28: Oil spills 10–100 barrels (where cause was indicated) – by cause – 2018 (Figure 44)

Cause	Number of spills	Quantity spilled to the environment (tonnes)	Quantity recovered (if reported) (tonnes)
Equipment failure (excluding corrosion)	25	88	24
Corrosion	110	476	158
Operator or technical error	29	104	33
Third party damage (sabotage, theft, vandalism, etc)	51	226	5
Other	21	96	32

NB: Quantity of oil recovered is not reported for all spills.

Table A.29: Oil spills 10–100 barrels (where cause was indicated) – by material spilled – 2018 (Figure 45)

	Material	Number of spills	Quantity spilled to the environment (tonnes)	Quantity recovered (if reported) (tonnes)
Excluding third party damage	Crude oil	142	572	196
Excluding third party damage	Condensate	16	85	29
Excluding third party damage	Processed oil	14	53	24
Excluding third party damage	Unspecified oil	15	61	3
Excluding third party damage	SUM TOTAL	187	770	252
Third party damage	Crude oil	49	220	5
Third party damage	Condensate	1	2	0
Third party damage	Processed oil	1	5	0
Third party damage	SUM TOTAL	51	226	5

NB: Quantity of oil recovered is not reported for all spills.

Table A.30: Oil spills 10–100 barrels (where cause was indicated) – by region – 2018

	Region	Number of spills	Quantity spilled to the environment (tonnes)	Quantity recovered (if reported) (tonnes)
Excluding third party damage	Africa	14	58	12
Excluding third party damage	Asia / Australasia	4	19	0
Excluding third party damage	Europe	13	76	2
Excluding third party damage	Middle East	9	28	27
Excluding third party damage	North America	97	362	208
Excluding third party damage	Russia & Central Asia	35	183	3
Excluding third party damage	South & Central America	15	43	0
Third party damage	Africa	44	206	1
Third party damage	Asia / Australasia	3	10	4
Third party damage	Europe	2	6	0
Third party damage	North America	2	4	0

NB: Quantity of oil recovered is not reported for all spills.

Table A.31: Oil spills 10–100 barrels (where cause was indicated) – by location – 2018

	Location	Number of spills	Quantity spilled to the environment (tonnes)	Quantity recovered (if reported) (tonnes)
Excluding third party damage	Onshore	164	657	243
Excluding third party damage	Offshore	21	107	6
Excluding third party damage	Unspecified	2	6	2
Third party damage	Onshore	50	225	4
Third party damage	Unspecified	1	1	1

NB: Quantity of oil recovered is not reported for all spills.

Table A.32: Number of chemical spills >1 barrel in size and quantity spilled per unit of hydrocarbon production (Figure 46)

Year	Location	Number of spills per million tonnes	Quantity spilled to the environment (tonnes/million tonnes)	Production (million tonnes)
2018	Onshore	0.29	2.05	666
2018	Offshore	0.13	2.04	821
2018	Unspecified	0.01	0.01	159
2018	OVERALL	0.18	1.85	1,646
2017	Onshore	0.23	0.68	532
2017	Offshore	0.14	1.62	828
2017	Unspecified	0.63	1.02	188
2017	OVERALL	0.23	1.22	1,548
2016	Onshore	0.20	0.94	516
2016	Offshore	0.17	0.79	759
2016	Unspecified	0.05	0.33	105
2016	OVERALL	0.17	0.81	1,380

NB: Quantity of material recovered is not reported for all spills.

Table A.33: Chemical spills onshore and offshore – by region

Year	Region	Location	Average size (tonnes)	Quantity spilled to the environment (tonnes)
2018	Africa	Onshore	0.27	2
2018	Africa	Offshore	1.51	1
2018	Asia / Australasia	Onshore	9.56	86
2018	Asia / Australasia	Offshore	0.83	4
2018	Europe	Onshore	1.02	1
2018	Europe	Offshore	17.36	850
2018	Europe	Unspecified	2.07	2
2018	Middle East	Onshore	1.35	1
2018	North America	Onshore	5.56	750
2018	North America	Offshore	53.48	588
2018	Russia & Central Asia	Onshore	4.2	21
2018	South & Central America	Onshore	16.19	501
2018	South & Central America	Offshore	5.6	235
2018	OVERALL (ALL regions)	Onshore	7.07	1,364
2018	OVERALL (ALL regions)	Offshore	15.55	1,679
2018	OVERALL (ALL regions)	Unspecified	2.07	2
2018	OVERALL (ALL regions)	OVERALL	10.09	3,045
2017	Africa	Onshore	12.6	25
2017	Africa	Offshore	10.81	10
2017	Africa	Unspecified	no data	0
2017	Asia / Australasia	Onshore	0.53	2
2017	Asia / Australasia	Offshore	2.14	17
2017	Asia / Australasia	Unspecified	3.23	12
2017	Europe	Onshore	3	2
2017	Europe	Offshore	20.42	1,163
2017	Europe	Unspecified	no data	0
2017	Middle East	Onshore	10.97	21
2017	Middle East	Offshore	22.99	22
2017	North America	Onshore	2.14	188

Year	Region	Location	Average size (tonnes)	Quantity spilled to the environment (tonnes)
2017	North America	Offshore	0.9	13
2017	North America	Unspecified	1.55	178
2017	Russia & Central Asia	Onshore	0.72	2
2017	Russia & Central Asia	Offshore	no data	0
2017	South & Central America	Onshore	5.35	117
2017	South & Central America	Offshore	3.2	115
2017	South & Central America	Unspecified	no data	0
2017	OVERALL (ALL regions)	Onshore	2.96	360
2017	OVERALL (ALL regions)	Offshore	11.38	1,343
2017	OVERALL (ALL regions)	Unspecified	1.61	191
2017	OVERALL (ALL regions)	OVERALL	5.28	1,895
2016	Africa	Onshore	0.2	0
2016	Africa	Offshore	4.76	14
2016	Africa	Unspecified	3.02	3
2016	Asia / Australasia	Onshore	6.81	34
2016	Asia / Australasia	Offshore	5.81	52
2016	Asia / Australasia	Unspecified	0.47	0
2016	Europe	Onshore	0.4	0
2016	Europe	Offshore	3.81	289
2016	Europe	Unspecified	15.5	31
2016	Middle East	Onshore	no data	0
2016	Middle East	Offshore	2	2
2016	North America	Onshore	4.6	289
2016	North America	Offshore	4.64	37
2016	Russia & Central Asia	Onshore	no data	0
2016	Russia & Central Asia	Offshore	no data	0
2016	South & Central America	Onshore	4.74	161
2016	South & Central America	Offshore	7.33	278
2016	South & Central America	Unspecified	no data	0
2016	OVERALL (ALL regions)	Onshore	4.67	485
2016	OVERALL (ALL regions)	Offshore	4.99	673
2016	OVERALL (ALL regions)	Unspecified	6.99	34
2016	OVERALL (ALL regions)	OVERALL	4.89	1,193

NB: Excludes spills <1 barrel in size.

Fresh water

Table A.34: Fresh water withdrawn for the purpose of use cubic metres per thousand tonnes production – by region (Figures 47 and 48)

Year	Region	Fresh water withdrawn (cubic metres per thousand tonnes production)*
2018	Africa	52.85
2018	Asia / Australasia	77.19
2018	Europe	38.05
2018	Middle East	4.09
2018	North America	488.19
2018	Russia & Central Asia	128.30
2018	South & Central America	102.67
2018	OVERALL (All regions)	112.58
2017	Africa	47.57
2017	Asia / Australasia	101.45
2017	Europe	48.16
2017	Middle East	4.63
2017	North America	461.70
2017	Russia & Central Asia	371.45
2017	South & Central America	95.92
2017	OVERALL (All regions)	125.29
2016	Africa	50.27
2016	Asia / Australasia	62.38
2016	Europe	41.84
2016	Middle East	3.14
2016	North America	360.14
2016	Russia & Central Asia	16.57
2016	South & Central America	111.42
2016	OVERALL (All regions)	90.02

**Data only included where fresh water withdrawn and hydrocarbon production quantities are both reported.*

Table A.35: Fresh water withdrawn - by source (Figures 47 and 48)

Year	Source	Fresh water withdrawn (cubic metres) - where sources were provided*
2018	Groundwater	60,505,509
2018	Surface water	82,230,746
2018	Municipal water supplies	9,629,847
2018	Treated municipal wastewater	461,038
2018	Captured rainwater	6,043,058
2018	Other sources	4,764,622
2018	Unspecified	17,734,676
2018	SUM TOTAL	181,369,499
2017	Groundwater	80,857,923
2017	Surface water	92,467,978
2017	Municipal water supplies	10,094,581
2017	Treated municipal wastewater	4,935
2017	Captured rainwater	2,775,400
2017	Other sources	4,503,526
2017	Unspecified	40,457,024
2017	SUM TOTAL	231,161,369
2016	Groundwater	43,386,062
2016	Surface water	66,688,387
2016	Municipal water supplies	8,850,552
2016	Treated municipal wastewater	36,714
2016	Captured rainwater	3,602,626
2016	Other sources	7,432,313
2016	Unspecified	38,395,902
2016	SUM TOTAL	168,392,559

**Data only included where information was on the sources was provided.*

Glossary

API

American Petroleum Institute.

Barrel, Bbl

In the energy industry, a barrel is 42 US gallons measured at 60° Fahrenheit. This is approximately 159 litres.

Base fluid

The continuous phase or suspending medium of a drilling fluid formulation.

CH_4

Methane, the principal constituent of natural gas. One of the primary greenhouse gases.

CO_2

Carbon dioxide, a colourless, odourless, and nonflammable gas. CO_2 emissions occur from the combustion of fossil fuels. CO_2 is a primary greenhouse gas.

Crude oil

A mixture of hydrocarbons that exists as a liquid in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Crude oil is the raw material that is refined into gasoline, heating oil, jet fuel, propane, petrochemicals, and other products.

Cuttings

The particles generated by drilling into subsurface geologic formations and carried out from the wellbore with the drilling fluid. Examples of drill cuttings include small pieces of rock varying in size and texture from fine silt to gravel.

Drilling fluid

The circulating fluid (also called 'mud') used in the rotary drilling of wells to clean and condition the hole and to counterbalance formation pressure. See definitions for 'water-based drilling fluid' and 'non-aqueous drilling fluid' below.

E&P

Exploration and Production (of hydrocarbons).

Emission rate

Emissions of gases per unit of hydrocarbon production.

Energy intensity

Energy consumed per unit of hydrocarbon production.

Exploration

Study of geological formations to detect the presence of hydrocarbons.

Flare (as an atmospheric emission source category)

Includes emissions generated by burning of gases (or in some cases liquids) in a thermal destruction device, including E&P flaring of associated gas (and in some cases liquids) from oil production or well testing. Typical equipment sources in this category include:

- Flares
- Thermal Oxidizers

Flaring

The controlled burning of natural gas produced in association with oil in the course of oil and gas exploration and production operations. It also includes the controlled and safe burning of gas which cannot be used for commercial or technical reasons.

Fresh water

The definition varies in accordance with local statutes and regulations. Where it is not defined by local regulations, fresh water is defined for reporting purposes as nonbrackish water and may include drinking water, potable water, water used in agriculture, etc. The total dissolved solids (TDS) concentration of this water type is up to 2000 mg/l.

Fuel combustion (as an atmospheric emission source category)

Includes emissions generated through the consumption of fuel. Typical fuel-consuming equipment types in E&P operations include:

- Turbines (e.g., driving compressors, generators and pumps)
- Internal Combustion Engines
- Heaters
- Boilers / Reboilers
- Mobile sources under company's operational control (see IPIECA/API/IOGP Petroleum industry guidelines for reporting greenhouse gas emissions)

Fugitive emission, fugitive losses

Unintended emissions released to the air, other than those from stacks or vents from the processing, transmission, and/or transportation of fossil fuels. They are often due to equipment leaks and evaporative processes.

Gaseous emission

Gaseous emissions to the atmosphere from flaring and venting, process and turbine combustion. Includes fugitive losses from pumps, valves, flanges, pipes, etc.

Gas-oil ratio

The volume of gas at atmospheric pressure produced per unit volume of oil produced.

Greenhouse gas

A gas that contributes to the natural greenhouse effect. The primary six greenhouse gases (GHGs) produced by human activities are: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. For the purpose of this report GHG considers only CO_2 and CH_4.

Hydrocarbon

An organic chemical compound of hydrogen and carbon (see petroleum).

Hydrocarbon production

Quantity of hydrocarbon gas and/or liquids produced.

IPIECA

The global oil and gas industry association for environmental and social issues.

Mud

Common term for drilling fluid.

Nitrogen Oxides (NO_X)

Nitrogen Oxides represent the sum of nitric oxide (NO) and nitrogen dioxide (NO_2) expressed as NO_2 equivalent. Nitrous oxide (N_2O) is not included as a component of NO_X. NO_X emissions occur from the combustion of fossil fuels for industry and transport and are a function of the type and quantity of fuel burned and the type of combustion device in which they are burned.

NMVOC

Non-methane volatile organic compounds: all hydrocarbons other than methane that can vaporise at normal temperature and pressure.

Non-aqueous drilling fluid (NADF)

A drilling fluid in which the continuous phase is a waterimmiscible fluid such as an oleaginous material (e.g., mineral oil, enhanced mineral oil, paraffinic oil, or synthetic material such as olefins and vegetable esters). NADFs serve many purposes under difficult drilling conditions. NADFs are usually reused.

Normalization

To compare emissions from different regions or sources it is useful to relate them to the size of the activity causing the emission. For example, tonnes of CO_2 can be presented by their ratio to tonnes of oil and gas produced. This procedure is called normalization.

Offshore

For this report 'offshore' refers to operations that take place at sea, including inland seas directly connecting to oceans. Operations in bays, in major inland seas, e.g., the Caspian Sea, or in other inland seas directly connected to oceans are counted as offshore.

Onshore

For this report 'onshore' refers to operations that take place within a landmass, including swamps, lakes, rivers and estuaries, but excluding major inland seas.

On-site combustion

The local combustion of fuels by E&P companies to produce energy for their operations.

Operator

Term used to describe a company appointed by venture stakeholders to take primary responsibility for day-to-day operations for a specific plant or activity.

Processing

The separation of oil, gas, and natural gas liquids and the removal of impurities.

Produced water (PW)

The water (generally brine) brought up from the hydrocarbon-bearing strata during the extraction of oil and gas, including formation water, injection water, and any chemicals added downhole or during the oil/water separation process. For the purposes of this report produced water discharges from crude oil and natural gas facilities are categorized by the source of production and not the location where they occur, i.e., where production is offshore and discharges are generated from an onshore facility, the discharges are reported as offshore.

Production

All production activities including production drilling, process and treatment, flaring and venting, in-field pipeline transport, and terminal operations. (see Hydrocarbon production).

Purchased energy

Energy purchased in the form of electricity or steam.

Sabotage

Deliberately destroy, damage, or obstruct (something).

SO_2

Sulphur dioxide (SO_2) can result from the combustion of H_2S and other sulphur containing compounds. In this report 'SO_2' refers to the sum of sulphur dioxide and sulphur trioxide (SO_2) expressed as SO_2 equivalent.

Source of emissions

In the case of gaseous emissions refers to the process by which the emissions are released. Source categories are Energy, Flare, Vent, Fugitive losses and Unspecified.

Spill

Any loss of containment from which the released material reaches the environment (i.e., is not retained within secondary or other confinement), irrespective of the quantity recovered. The volume of a spill represents the gross volume reaching the environment, not a net volume remaining in the environment after response. Spills occurring from support and standby vessels are included but spills of produced water or process waste water are excluded. Includes loss of containment resulting from acts of sabotage (such as theft of oil from pipelines and storage, or vandalism); excludes loss as a result of 'acts of terrorism'/attacks on infrastructure.

Synthetic-based drilling fluid

A drilling fluid that has a synthetic material as its continuous phase with water as the dispersed phase. Synthetic-based drilling fluids are a subset of nonaqueous drilling fluids.

Synthetics

Synthetic material as applied to synthetic-based drilling fluid means material produced by the reaction of specific purified chemical feedstock, as opposed to the traditional base fluids such as diesel and mineral oil which are derived from crude oil solely through physical separation processes.

Tonne

A metric tonne; equivalent to 1,000 kilograms or 2,205 pounds.

Transport

The transfer of hydrocarbons from the site of production to the point of commercial metering or terminal or offshore loading device.

Upstream industry

Those operations within the industry to the point where the produced resource is metered into the transportation system. This includes Exploration and Production.

Venting

The controlled release of unburned gas to the atmosphere.

Water-based drilling fluid (mud)

A drilling fluid in which water or a water miscible fluid is the continuous phase and the suspending medium for solids, whether or not oil is present.

Wilful damage

Wilful or malicious damage or destruction of the property of another.

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The International Association of Oil and Gas Producers (IOGP) has collected environmental data from its Member Companies every year since 1999.

The objective of this programme has been to allow member companies to compare their performance with other companies in the sector leading, it is hoped, to improved and more efficient performance. The programme also contributes to the industry's wish to be more transparent about its operations.

This report summarizes information on exploration and production (E&P) activities carried out by contributing IOGP Member Companies in 2018.

www.data.iogp.org