PRODUCTION

Danish Energy Agency

20 December 2016

PRODUCTION

Oil production in 2015 totalled 9.1 million m^3, a 5.5 per cent decline on 2014. Compared to 2014, gas sales were maintained at a stable level of 3.8 billion Nm^3.

Danish oil production in 2015 was about 5 per cent lower than forecast. Gas sales were forecast to amount to 4.1 billion Nm^3 in 2015. Several unplanned shutdowns, including at the Tyra Field, impacted the amount of production, particularly gas production.

The trend of declining production since 2006 seems to continue. Activities have focused on preventive maintenance and well maintenance, at the same time as work has proceeded on extending the South Arne Field with a northern platform. The production from new wells from South Arne's northern platform and from Tyra SE has helped counter the fall in production.

The content of water relative to the total liquids produced increased in 2015, now amounting to 80 per cent. Compared to 2014, the volume of produced water rose by 9.4 per cent.

For technical and safety reasons, gas is flared on all offshore platforms with processing facilities. The total volume of gas flared increased by just over 6 per cent from 2014 to 2015. The combustion of natural gas and diesel oil and gas flaring produce CO_2 emissions to the atmosphere. Emissions rose slightly in 2015 compared to 2014.

2015 was the first full year in which production from the Siri Field and the associated satellite fields, Nini and Cecilie, was not significantly impacted by repairs to the tank console under the Siri platform. Cracks were identified in the tank console in 2009 and 2013, which resulted in the shutdown of production from the fields for a lengthy period. Production from the Nini and Cecilie Fields was resumed in January 2014, with the production being loaded directly into tankers, and in autumn 2014 production was back to normal for all three fields, Siri, Nini and Cecilie. Production from Siri, Nini and Cecilie was about 7 per cent lower than forecast due to unplanned shutdowns.

The northern part of the South Arne Field was further developed with a new platform in 2015, and new wells came on stream in the course of 2015. New wells continue to be drilled in 2016. Production from the South Arne Field totalled 1 million m^3 of oil and 0.2 billion Nm^3 of sales gas in 2015. The amount produced was down by one-third compared to the forecast. The drop in production occurred because of unplanned shutdowns and because the production startup from new wells did not progress as expected.

The DUC has carried on production in the North Sea since 1972 under the Sole Concession, and many of their installations are now of a mature age. For the purpose of carrying out extensive maintenance work and replacing equipment, the operator, Mærsk Olie og Gas A/S, has therefore shut down selected fields during the summer for a number of years. Thus, a new pipeline to the Rolf, Roar and Valdemar Fields was installed in the course of 2015.

The amount of oil produced under the Sole Concession totalled 7.5 million m^3 of oil, as forecast, while the production of sales gas amounted to 3.5 billion Nm^3, down by about 4 per cent compared to the forecast, due to unplanned shutdowns.

The new Tyra SE platform B (TSB) received the first oil produced from the new wells in March 2015. The unmanned TSB platform was installed in 2014 and can receive production from up to 16 new wells.

Production was suspended on the Svend Field, and all wells were temporarily abandoned at the end of 2015. The Concessionaires and the authorities are assessing the future of the Svend Field.

An outline of all 19 producing fields, including annual production figures, is available at the DEA's website. These statistics date back to 1972, when production started in Denmark.

PRODUCTION FACILITIES IN THE NORTH SEA

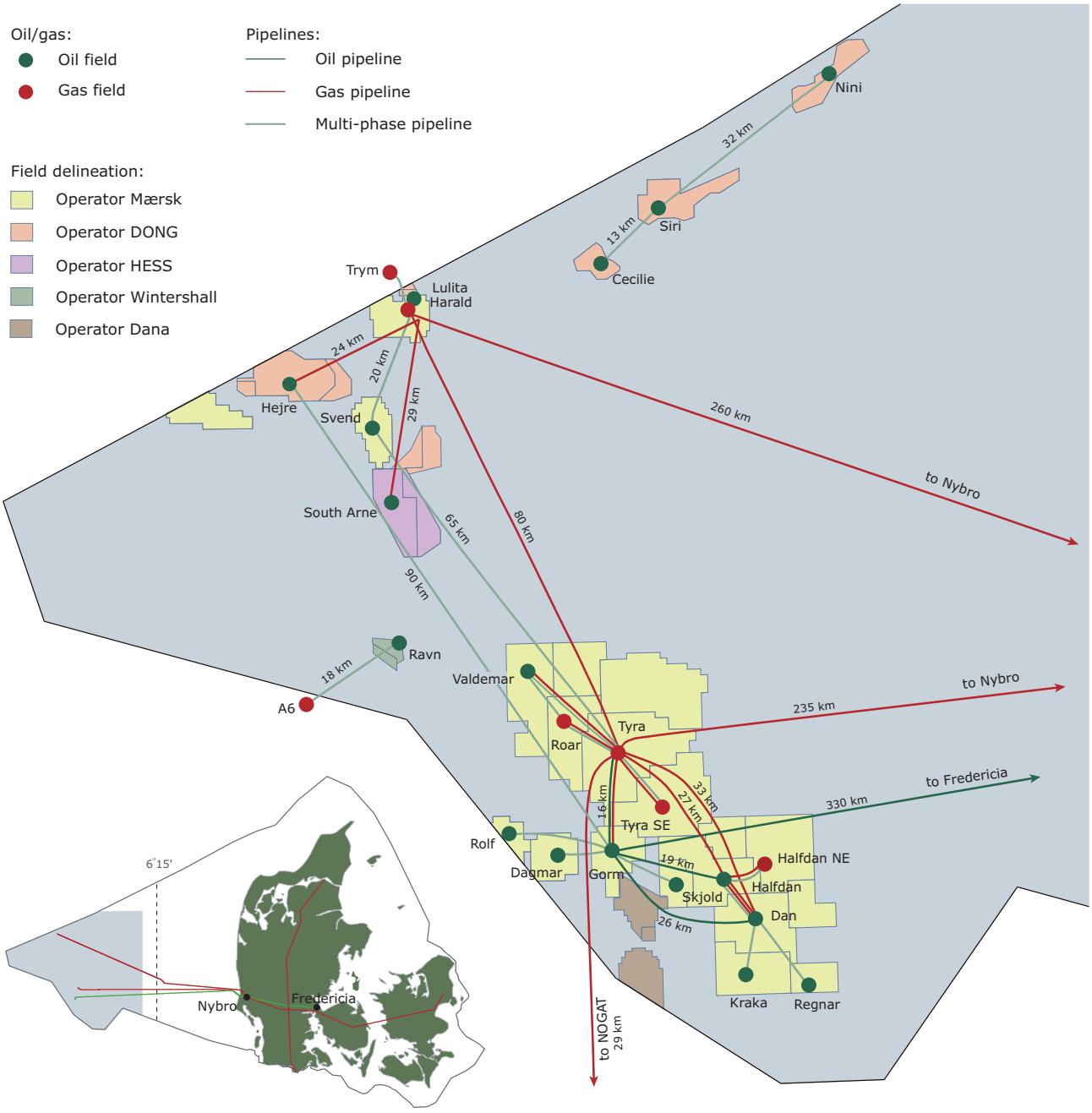


Figure 1. Location of production facilities in the North Sea 2015

All producing fields in Denmark are located in the North Sea and appear from this figure, which also shows the key pipelines. In total, there are currently 19 fields that have been or are in production, and three operators are responsible for production from these fields: DONG E&P A/S, Hess Denmark ApS and Mærsk Olie og Gas A/S. The Hejre and Ravn Fields are under establishment, but have yet to start producing.

PRODUCTION IN 2015

Oil production in 2015 totalled 9.1 million m^3, equal to 157,000 barrels/day, a 5 per cent decline compared to 2014. The production of natural gas totalled 4.5 billion Nm^3 in 2015, of which 3.8 billion Nm^3 of gas was exported ashore as sales gas, the same volume as in 2014.

The trend of declining production since 2006 seems to continue. The main reason for the decline in production over the past decade is that the majority of fields have already produced the bulk of the anticipated recoverable oil. In addition, ageing fields require more maintenance as regards wells, pipelines and platforms. This maintenance work often causes a loss or delay in production, as the wells and possibly even the entire platform must be shut down while the work is carried out.

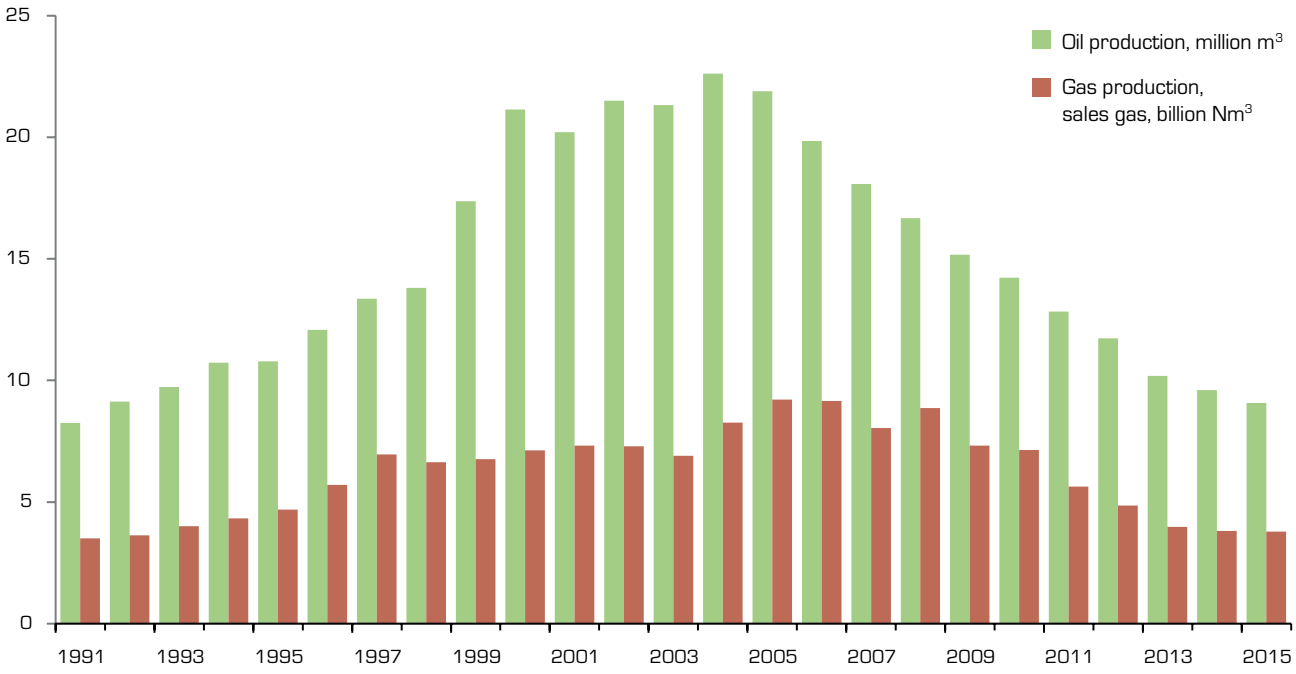


Figure 2. Production of oil and gas 1991-2015

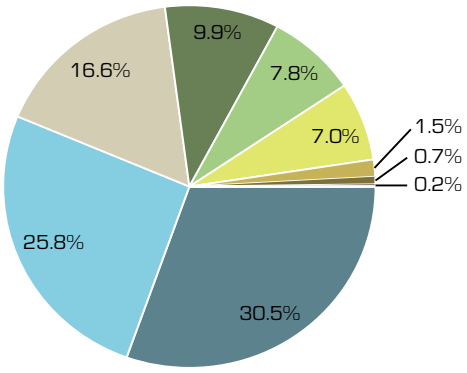
TABLE 1. OIL PRODUCTION

Thousand cubic metres

	1972-2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
DAN	90,999	4,241	3,549	2,979	2,474	2,260	2,045	1,794	1,592	111,933
GORM	56,040	1,053	924	923	713	593	543	425	451	61,665
SKJOLD	40,571	989	918	835	778	679	605	587	515	46,477
TYRA	24,214	551	415	856	744	626	521	501	462	28,890
ROLF	4,212	78	76	60	1	0	0	0	78	4,505
KRAKA	4,778	112	37	67	170	129	101	89	146	5,629
DAGMAR	1,005	0	0	0	0	0	0	0	0	1,005
REGNAR	930	0	0	0	0	0	0	0	0	930
VALDEMAR	4,335	1,268	1,410	909	817	844	777	762	637	11,759
ROAR	2,509	28	30	24	16	2	4	6	6	2,625
SVEND	6,301	278	195	190	145	171	183	160	136	7,759
HARALD	7,632	114	65	70	95	79	25	21	21	8,122
LULITA	833	47	24	36	36	32	17	26	18	1,069
HALFDAN	35,394	5,326	5,465	5,119	4,905	4,617	4,150	3,674	3,345	71,995
SIRI	10,383	598	326	286	161	238	131	94	200	12,417
SOUTH ARNE	17,784	1,139	1,164	1,066	1,004	803	700	1,023	1,030	25,713
TYRA SE	2,852	429	374	225	165	148	98	91	118	4,500
CECILIE	863	66	38	33	39	33	17	10	23	1,122
NINI	3,192	355	159	544	569	475	268	336	299	6,197
I ALT	314,827	16,672	15,169	14,222	12,832	11,729	10,185	9,599	9,077	414,312

BREAKDOWN OF OIL PRODUCTION BY COMPANY IN 2015

A total of 11 companies participated in production from Danish fields in 2015. DUC is the largest producer, accounting for 83 per cent of oil production and 91 per cent of gas exports.



30.5 per cent, Shell Olie og Gasudvinding Danmark B.V.
25.8 per cent, A.P. Møller - Mærsk A/S
16.6 per cent, Nordsøfonden
9.9 per cent, Chevron Denmark
7.8 per cent, DONG E&P A/S
7.0 per cent, Hess Denmark ApS
1.5 per cent, DEA Deutsche Erdoel AG
0.7 per cent, DONG E&P (Siri) UK Limited
0.2 per cent, Danoil Exploration A/S
< 0.0 per cent, DONG E&P DK A/S
< 0.0 per cent, Noreco Petroleum Denmark A/S
< 0.0 per cent, Noreco Oil Denmark A/S

Figure 3. Breakdown of oil production by company in 2015

USE OF PRODUCTION

Gas production totalled 4.5 billion Nm^3 in 2015. Sales gas accounted for about 84 per cent of total gas production.

The remainder of the gas produced was either reinjected into selected fields to improve recovery or used as fuel on the platforms. A small volume of unutilized gas is flared for technical and safety reasons.

13 per cent of the gas produced was used as fuel in 2015. Flaring accounted for 2 per cent of gas production, while 1 per cent was reinjected into the Siri Field.

The general increase in fuel consumption until 2007 is attributable to rising oil and gas production and ageing fields. The reason for the sharp drop from 2008 is primarily energy efficiency measures taken by the operators.

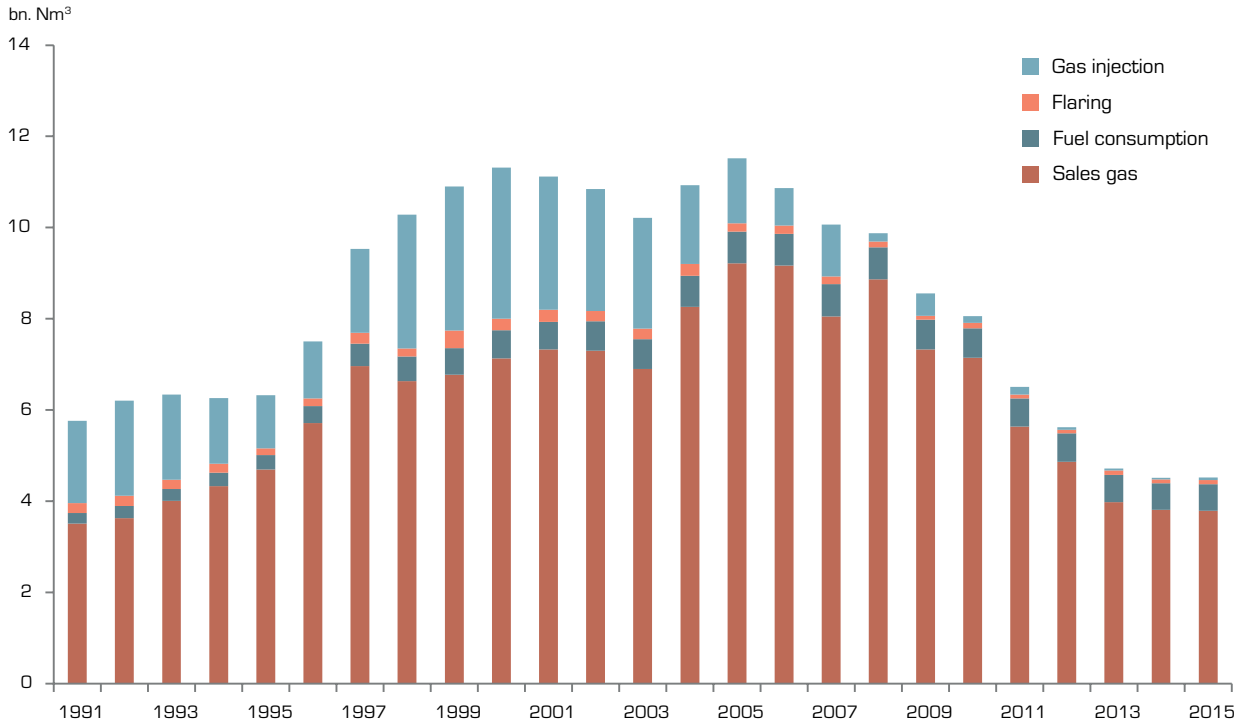


Figure 4. Use of gas production in the period 1991-2015

TABLE 2. GAS PRODUCTION

Million normal cubic metres

	1972-2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
DAN	21,531	467	364	360	327	330	416	408	361	24,564
GORM	15,231	119	109	99	67	52	60	36	46	15,819
SKJOLD	3,343	60	58	87	69	62	70	68	64	3,881
TYRA	81,468	3,130	2,007	1,664	1,320	1,404	1,618	1,474	1,217	95,302
ROLF	177	3	3	3	0	0	0	0	5	191
KRAKA	1,348	36	8	12	46	35	20	18	36	1,559
DAGMAR	158	0	0	0	0	0	0	0	0	158
REGNAR	63	0	0	0	0	0	0	0	0	63
VALDEMAR	1,808	593	510	791	579	515	368	343	291	5,798
ROAR	13,689	417	398	213	171	24	28	46	40	15,026
SVEND	740	24	16	27	24	27	20	16	15	909
HARALD	19,608	690	400	592	573	541	174	274	389	23,241
LULITA	537	30	15	18	20	19	11	18	11	679
HALFDAN	12,292	3,104	3,401	2,886	2,343	1,709	1,389	1,309	1,394	29,827
SIRI	1,058	63	44	67	48	48	35	13	63	1,439
SOUTH ARNE	4,425	225	271	248	238	194	167	238	307	6,313
TYRA SE	5,426	889	939	911	626	610	306	201	248	10,156
CECILIE	62	4	2	2	3	3	1	6	3	86
NINI	236	26	12	76	57	40	22	35	25	529
I ALT	183,200	9,880	8,557	8,056	6,511	5,613	4,705	4,503	4,515	235,540

TABLE 3. GAS, EXPORT OF SALES GAS PRODUCED IN DENMARK

Million normal cubic metres

	1972-2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
TYRA EAST	111,537	6,666	5,551	6,228	4,807	3,739	2,808	3,164	3,106	147,606
SOUTH ARNE	3,824	167	212	199	180	130	108	182	243	5,245
TYRA WEST	7,325	2,032	1,560	715	648	994	1,066	467	437	15,244
I ALT	122,686	8,865	7,323	7,142	5,635	4,863	3,982	3,813	3,786	168,095

TABLE 4. GAS, FUEL*

Million normal cubic metres

	1972-2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
DAN	2,625	225	207	206	179	167	178	175	187	4,149
GORM	2,661	117	116	111	107	107	105	93	92	3,509
TYRA	3,802	233	219	208	188	171	150	149	150	5,270
DAGMAR	21	0	0	0	0	0	0	0	0	21
HARALD	102	7	4	8	16	17	12	15	17	198
SIRI	182	25	19	27	28	26	16	17	27	365
SOUTH ARNE	371	53	54	55	41	64	60	55	59	812
HALFDAN	137	38	39	36	62	76	77	76	74	614
TOTAL	9,901	699	658	651	620	628	597	580	605	14,939

TABLE 5. GAS, FLARING*

Million normal cubic metres

	1972-2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
DAN	2,024	25	17	12	13	13	14	15	18	2,150
GORM	1,756	41	19	12	14	15	18	22	22	1,920
TYRA	1,148	44	32	23	28	25	41	30	26	1,397
DAGMAR	135	0	0	0	0	0	0	0	0	135
HARALD	136	2	2	3	3	2	11	2	2	164
SIRI	221	7	4	58	6	4	3	4	5	312
SOUTH ARNE	234	7	7	6	11	5	3	5	11	289
HALFDAN	81	8	4	5	6	6	7	8	6	130
TOTAL	5,736	132	85	119	81	71	97	85	90	6,496

TABLE 6. GAS, INJECTION

Million normal cubic metres

	1972-2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
GORM	8,164	0	0	0	0	0	0	0	0	8,164
TYRA	35,760	119	451	89	94	0	0	0	0	36,513
SIRI	955	61	35	57	74	62	41	21	61	1,367
CECILIE	0	0	0	0	0	0	0	14	0	14
NINI	0	0	0	0	0	0	0	1	1	2
I ALT	44,879	180	486	146	168	62	41	36	62	46,060

* Including contributions from Trym

WATER PRODUCTION AND WATER INJECTION

Water is produced as a by-product in connection with the production of oil and gas. The water can originate from natural water zones below the reservoirs and from the water injection that is carried out in order to enhance oil production.

The content of water relative to the total liquids produced in the Danish part of the North Sea is increasing and reached 80 per cent in 2015. A high amount of energy is required to handle these large volumes of produced water, which exceeds 90 per cent for some of the old fields.

The production of water declined during the period from 2008 to 2014. In 2015 water production rose again to 35.5 million Nm^3, equal to an increase of 9.4 per cent on 2014, which is mainly attributable to the Siri, Nini and Halfdan Fields. In 2015 water injection increased by 9.9 per cent relative to 2014.

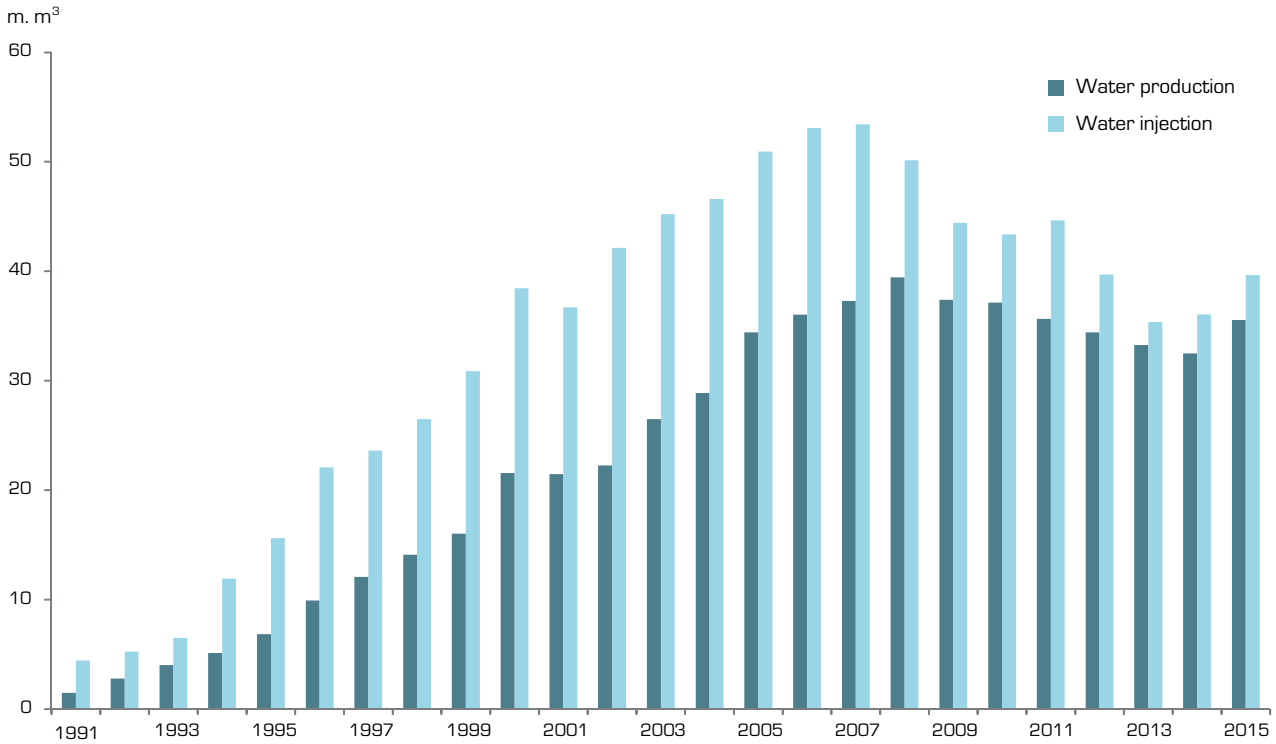


Figure 5. Water production and water injection 1991-2015

TABLE 7. WATER, PRODUCTION

Thousand cubic metres

	1972-2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
DAN	81,343	13,946	12,889	12,111	11,059	10,468	11,207	11,494	12,297	176,814
GORM	54,523	3,976	4,737	4,904	4,654	3,897	3,658	2,833	3,525	86,707
SKJOLD	47,403	3,636	3,855	3,895	3,861	3,978	4,023	3,865	4,281	78,797
TYRA	37,543	3,103	2,677	1,980	1,811	1,516	2,063	1,678	1,677	54,048
ROLF	5,843	349	381	281	8	0	0	0	100	6,962
KRAKA	4,567	436	183	166	358	237	170	214	362	6,693
DAGMAR	3,914	13	0	0	0	0	0	0	0	3,927
REGNAR	4,064	0	0	0	0	0	0	0	0	4,064
VALDEMAR	3,933	925	812	1,207	1,026	893	916	873	642	11,227
ROAR	4,308	586	624	275	200	34	59	98	107	6,291
SVEND	10,356	1,022	804	664	585	685	712	650	561	16,039
HARALD	335	21	11	37	113	152	47	20	21	757
LULITA	311	91	49	65	73	86	48	76	42	841
HALFDAN	14,234	4,766	4,814	5,519	6,149	6,139	6,099	6,574	7,344	61,638
SIRI	18,755	2,686	1,778	2,868	2,593	2,879	1,481	943	2,917	36,900
SOUTH ARNE	8,021	2,174	2,285	2,068	1,883	2,317	2,198	2,369	2,655	25,970
TYRA SE	2,795	602	716	568	485	440	235	286	284	6,411
CECILIE	2,219	456	266	317	452	390	179	138	271	4,688
NINI	2,235	660	522	195	330	297	166	376	627	5,408
I ALT	306,702	39,448	37,403	37,120	35,640	34,408	33,261	32,487	37,713	592,013

TABLE 8. WATER, INJECTION

Thousand cubic metres

	1972-2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
DAN	208,108	19,275	16,712	15,148	14,508	11,684	10,148	11,568	13,364	320,515
GORM	110,681	5,251	4,777	4,408	5,459	3,709	3,549	2,735	2,562	143,131
SKJOLD	97,192	4,989	5,285	4,155	4,374	5,093	4,956	4,624	5,063	135,731
HALFDAN	47,012	12,727	11,485	11,945	12,277	10,912	10,921	11,403	10,760	139,442
SIRI	25,920	2,695	1,692	2,692	3,201	3,020	1,592	1,788	2,930	45,530
SOUTH ARNE	31,993	4,279	3,872	3,427	3,240	4,104	3,660	3,368	3,281	61,224
CECILIE	413	42	97	47	221	35	0	0	0	855
NINI	2,825	883	501	1,558	1,365	1,151	549	575	1,679	11,086
I ALT	524,144	50,141	44,421	43,380	44,645	39,708	35,375	36,061	39,639	858,022

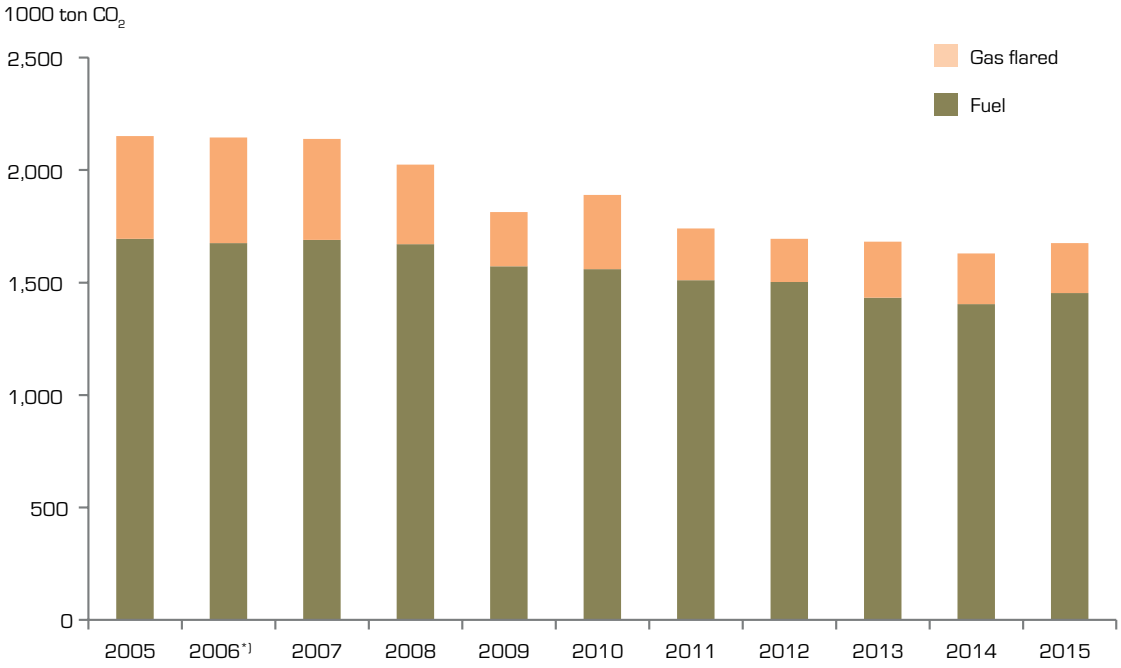
EMISSIONS TO THE ATMOSPHERE

Emissions to the atmosphere consist of such gases as CO_2 (carbon dioxide) and NOx (nitrogen oxide).

The combustion of natural gas and diesel oil and gas flaring produce CO_2 emissions to the atmosphere. Producing and transporting oil and gas require substantial amounts of energy. Furthermore, a certain volume of gas has to be flared for safety or plant-related reasons. Gas is flared on all offshore platforms with production facilities, and for safety reasons gas flaring is necessary in cases where installations must be emptied of gas quickly. The Danish Subsoil Act regulates the volumes of gas flared, while CO_2 emissions (including from flaring) are regulated by the Danish Act on CO_2 Allowances.

The volume emitted by the individual installation or field depends on the scale of production as well as plant-related and natural conditions.

Energy consumption per produced ton oil equivalent (t.o.e.) increases the longer a field has carried on production. This is because the water content of production increases over the life of a field. Assuming unchanged production conditions, the rising water content results in an increased need for injecting lift gas, and possibly water, to maintain pressure in the reservoir. Both processes are energy-intensive.



*) As from 2006, the figures have been based on verified CO_2 emission data from reports filed under the Act on CO_2 Allowances and have included CO_2 emission from diesel combustion on the production facilities.

Figure 6. CO_2 emissions from production facilities in the North Sea

CO_2 emissions from the production facilities in the North Sea totalled about 1.676 million tons in 2015, a minor increase on 2014, but the general trend of slightly falling emissions over the past decade is still evident.

FLARING

Gas flaring totalled 90 million Nm^3 in 2015, an increase of just over 6 per cent on 2014. The volume of gas flared depends in part on the design and layout of the individual installation, but not on the volumes of gas or oil produced.

Generally, the flaring of gas has declined substantially in the past ten years due to more stable operating conditions on the installations, changes in operations and focus on energy efficiency, such as the use of flare gas recovery systems at South Arne and Siri.

However, flaring may vary considerably from one year to another, frequently because of the tie-in of new fields and the commissioning of new facilities. Moreover, when platforms are shut down temporarily, the pressure must be vented and the gas evacuated from the inter-field pipelines must be flared.

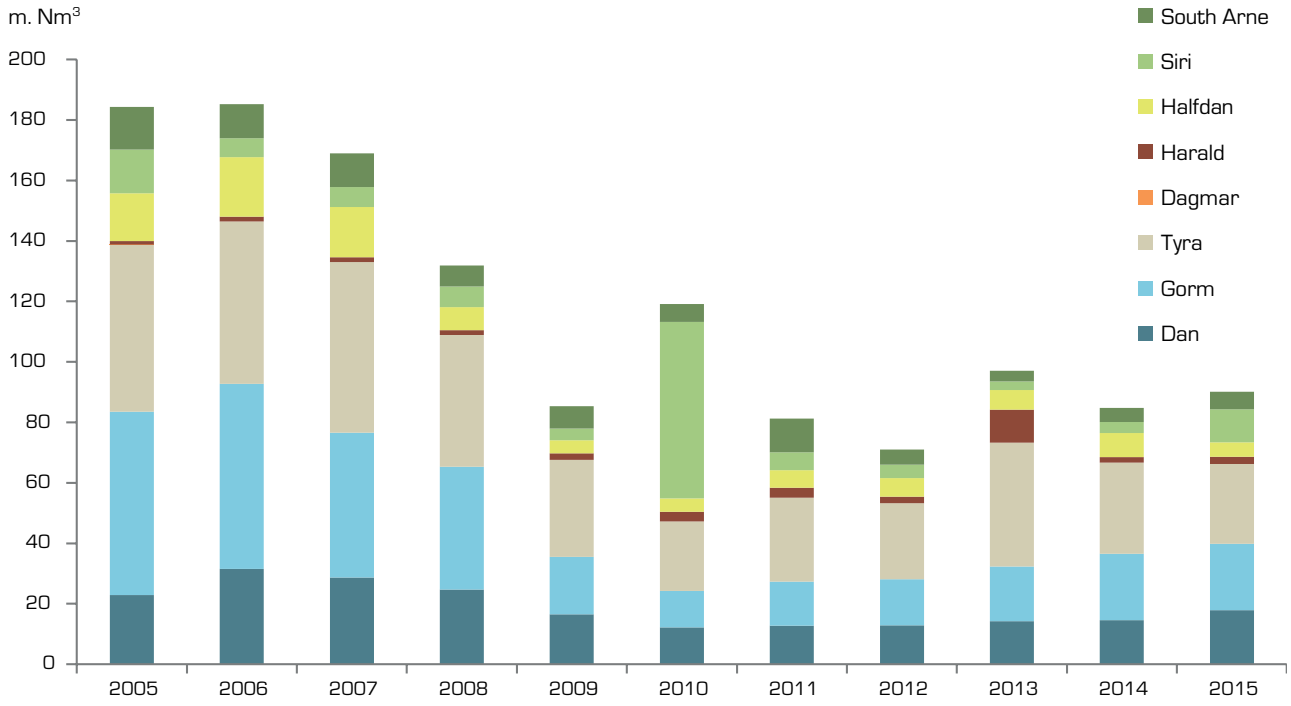


Figure 7. Gas flaring