RESERVES AND CONTINGENT RESOURCES

The DEA makes an assessment of Danish oil and gas resources annually. A description of the classification system is available at the DEA's website, www.ens.dk. Below the assessed reserves and contingent resources as of January 2011 are examined.

At 1 January 2011, the sum total of reserves and contingent resources are assessed at 185 million m^3 of oil and 101 billion Nm^3 of gas respectively.

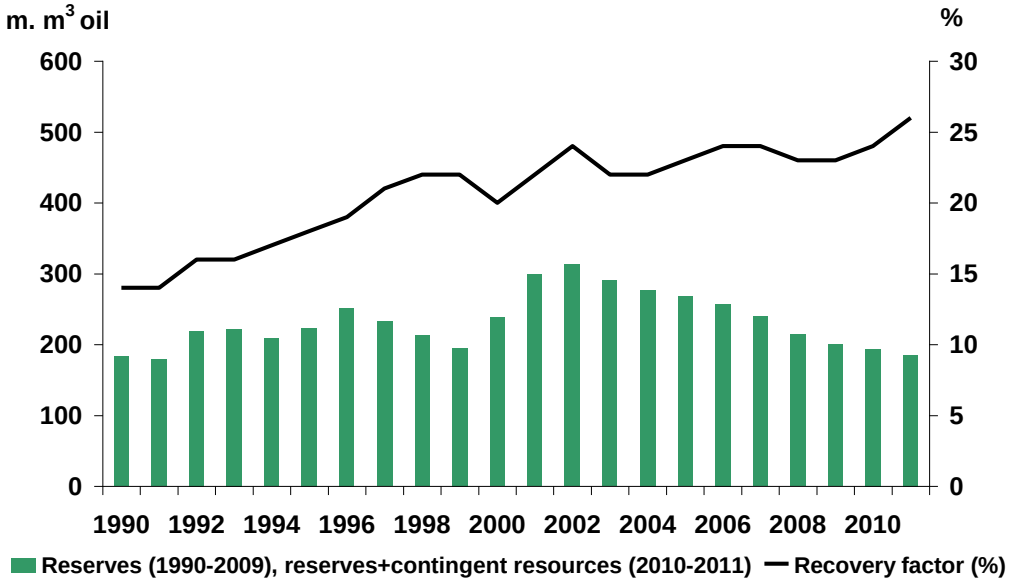
The sum total of reserves and contingent resources of 194 million m^3 oil in 2010 should be compared with the oil reserves of 185 million m^3 in 2011. Oil production totalled 14.2 million m^3 in 2010 and the estimate of future recovery has been adjusted upwards by 5 million m^3, which results in a difference of 9 million m^3 of oil between the two assessments. The upward adjustment of future recovery is due mainly to the inclusion of additional reserves attributable to the further development of the South Arne Field.

For the purpose of assessing net gas, the sum total of reserves and contingent resources of 101 billion Nm^3 in 2011 should be compared with the sum total of reserves and contingent resources of 105 billion Nm^3 in 2010. Gas production in 2010 totalled 7.9 billion Nm^3, and the estimate of future recovery has been written up by 4 billion Nm^3, which means that the difference between the two assessments amounts to 4 billion Nm^3 of gas. The upward adjustment of future recovery is due mainly to an increase of the reserves in the Tyra Field.

The development in oil reserves since 1990 appears from figure 1. For 2010 and 2011 the sum total of reserves and contingent resources is noted. The reserves assessed recently are of the same magnitude as the reserves for the start of the period. Furthermore, the figure shows that oil reserves have declined in the past nine years.

Based on the sum total of assessed reserves and contingent resources at 1 January 2011 the average oil recovery factor expected for oil is 26 per cent, an increase of 2 percentage point relative to last year's assessment, mainly because of a writedown of the oil-in-place on the Tyra and Dan Fields, see figure 1. The average recovery factor is the ratio of ultimate recovery to total oil-in-place. The recovery factor has increased from 14 per cent to 26 per cent for the period illustrated, mainly caused by further development of the fields with horizontal wells and water injection.

Fig. 1 Reserves and recovery factor, oil



R/P Ratio and production

Oil reserves can be put into perspective by calculating the ratio of reserves to the previous year's production. Such a calculation results in a so-called *R(reserves) /P(production)* ratio, which is an indicator of the calculated number of years for which oil production is estimated to be sustained at the same level.

Based on the reserves assessment of 1 January 2011, the R/P ratio is 10, meaning that oil production is calculated to be sustainable at the 2010 level for the next 10 years. The R/P ratio was 10 according to the previous assessment made at 1 January 2010.

For the assessments of 1 January 2010 and of 1 January 2011 comparing the R/P ratio with former assessments should be done by adding reserves and contingent resources. The ratio is 13, adding reserves and contingent resources for the present assessment and is unchanged compared to the previous assessment.

The R/P ratio is frequently used because it yields a comparable measure of how long reserves will last. However, this ratio cannot replace an actual forecast, especially not if large variations in the size of future production are expected.

Few major producers

It is characteristic, that a few fields only have produced the bulk of Danish oil, and that the oil reserves are concentrated in relatively few fields.

Dan, Gorm and Skjold are the three oldest, producing Danish fields. These fields account for 57 per cent of total oil production, and due to their development with horizontal wells and water injection, they still contain considerable reserves.

Reserves and contingent resources of the Dan, Gorm, Skjold, Halfdan and South Arne Fields are estimated to represent about 58 per cent of total Danish oil reserves and contingent resources. The remaining 42 per cent of the potential derive from more than 30 fields and discoveries.

On average, the overall recovery factor for all Danish fields and discoveries is estimated at 26 per cent. In fields like Dan, Gorm and Skjold, where the production conditions are favourable, an average recovery factor of about 37 per cent is expected, based on water injection as the main recovery method. However, the assessment also includes contributions from the relatively large oil accumulations in the Tyra and Tyra Southeast Fields, where the recovery factors are fairly low due to difficult production conditions.

Table 1 shows the DEA's assessment of production, reserves and contingent resources for oil and gas, broken down by field and category. The expected estimate is given for reserves and contingent resources.

It appears from figure 2 that the expected oil reserves have been assessed at 143 million m^3, and the contingent resources are estimated at 42 million m^3. The potential in the category contingent resources reflect the increasing uncertainty as to whether such resources can be exploited technically and/or commercially.

Fig. 2 Oil recovery at 1 January 2011, m. m^3

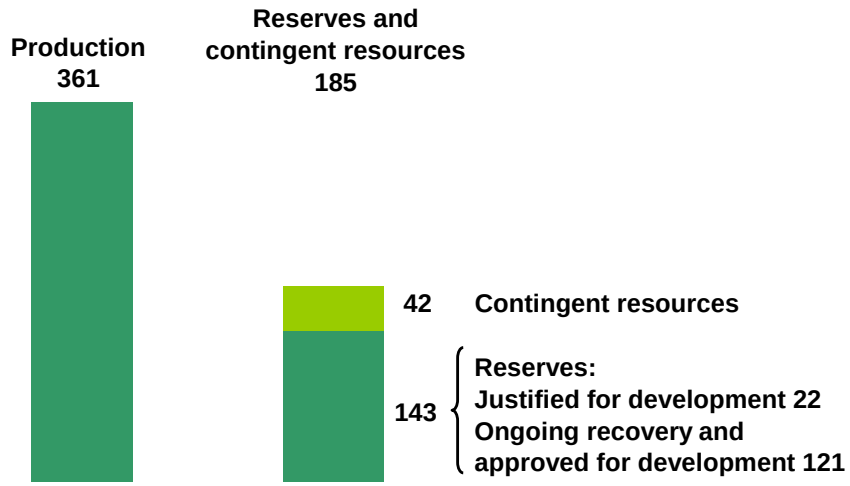
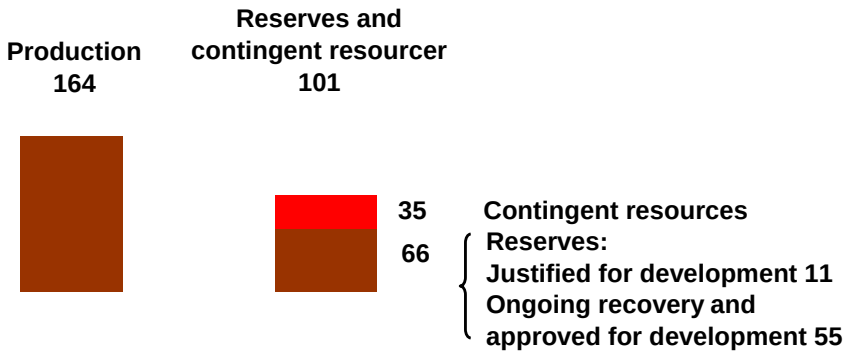


Fig. 3 Gas recovery at 1 January 2011, bn. Nm^3



Likewise, figure 3 illustrates that the expected gas reserves have been assessed at 66 billion Nm^3, and the contingent resources are assessed at 35 billion Nm^3. Gas production figures represent the net production, i.e. produced gas less reinjected gas.

There have been several revisions of the DEA's reserves assessment compared to the assessment made at January 2010. These revisions are mainly attributable to more production experience and new reservoir models of some of the fields resulting from improved knowledge of such fields.

Fields and categories where significant revisions of reserves and contingent resources have been made are described below.

Reserves
The category *ongoing recovery and approved for development*:
The oil reserves from the Dan Field have been written up based on the most recent production experience, and the oil reserves from Halfdan have been written up based on production experience and further development.

In October 2010 a plan for further development of the South Arne Field was approved. Thus the expected production from the development has been included in this category.

The gas reserves from the Tyra Field have been written up based on a revision of the potential for low pressure compression, and the write-up of the total gas reserves is mainly caused by this write-up.

The category *justified for development* comprises contributions for recovery from the Fields Dan, Gorm and Hejre.

Contingent resources
The DEA has reviewed a number of options for increasing the recovery with the use of known technology, i.e. technology that is used today under conditions comparable to those prevailing in the North Sea.

Based on reservoir calculations and general estimates of investments, operating costs and oil price developments, it is assessed that it is possible to recover additional oil and gas from a number of fields.

In the category *development pending* further recovery from the Fields Adda, Alma, Amalie, Boje area, Elly, Freja, Gorm, Halfdan, Tyra and Valdemar is included.

The category *development unclarified* comprises additional recovery from the fields Halfdan South Arne and Tyra.

The category *development not viable or on hold* includes discoveries not considered commercially viable under the existing conditions.

Table 1 Production, reserves and contingent resourcers at 1 January 2011

OIL, m. m³	Produced	Resources Exp.
		Reserves
Ongoing recovery and approved for development		
Cecilie	1.0	0.3
Dagmar	1.0	0.0
Dan	101.8	17.0
Gorm	58.9	5.5
Halfdan	51.3	49.2
Harald	7.9	0.4
Kraka	5.0	0.6
Lulita	0.9	0.3
Nini	4.3	2.2
Regnar	0.9	0.0
Roar	2.6	0.1
Rolf	4.4	0.6
Siri	11.6	1.2
Skjold	43.3	8.6
South Arne	211.1	14.5
Svend	7.0	0.4
Tyra**	29.9	11.3
Valdemar	7.9	9.3
Justified for development	-	22
Subtotal	**361**	**143**
		Contingent resources
Development pending	-	*22*
Development unclarified	-	*8*
Development not viable	-	*11*
Subtotal		**42**
Total	**361**	**185**
January 2010	347	194

GAS, bn. Nm³	Net produced*	Resources Net gas* Exp.	Resources Sales gas* Exp.
		Reserves	
Ongoing recovery and approved for development			
Cecilie	0.1	-	-
Dagmar	0.2	0.0	0
Dan	22.7	2.7	0
Gorm	7.4	0.6	0
Halfdan	21.7	12.7	10
Harald	21.3	2.6	3
Kraka	1.4	0.1	0
Lulita	0.6	0.2	0
Nini	0.4	-	-
Regnar	0.1	0.0	0
Roar	14.7	0.6	1
Rolf	0.2	0.0	0
Siri	0.1	-	-
Skjold	3.5	0.7	0
South Arne	5.2	3.1	2
Svend	0.8	0.0	0
Tyra**	60.0	25.7	21
Valdemar	3.7	6.2	6
Justified for development	-	11	9
Subtotal	**164**	**66**	**52**
		Contingent resources	
Development pending	-	*21*	*19*
Development unclarified	-	*4*	*4*
Development not viable	-	*10*	*9*
Subtotal		**35**	**32**
Total	**164**	**101**	**84**
January 2010	156	105	85

*) *Net production: historical production less injection*
Net gas: future production less injection
Sales gas: future production less injection and less fuel gas and flaring
**) *Tyra Southeast included*