



Established by law in 1976, the Danish Energy Authority, DEA, is an authority under the Ministry of Transport and Energy that deals with matters relating to the production, supply and use PRIVATE of energy. On behalf of the Government, its task is to ensure that the Danish energy sector develops in a manner appropriate to society, the environment and safety.

The DEA prepares and administers Danish energy legislation, analyzes and evaluates developments in the energy sector, and makes forecasts and assessments of Danish oil and gas reserves.

The DEA works closely with local, regional and national authorities, energy distribution companies and licensees, etc. At the same time, the DEA maintains relations with international partners in the energy area, including the EU, IEA, as well as the Nordic Council of Ministers.

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Published: June 2007  
Number printed: 1,500

Photos: Photos made available by DONG Energy A/S, Mærsk Oil og Gas AS, Esvagt A/S, Maersk Contractors and Niels Åge Skovbo.  
Editor: Helle Halberg, the Danish Energy Authority  
Maps and illustrations: Jesper Jensen, the Danish Energy Authority and Metaform

Print: Scanprint AS  
Printed on: Cover: 200 g; content: 130 g  
Layout: Metaform and the Danish Energy Authority  
Translation: Rita Sunesen  
ISBN 978-87-7844-659-6  
ISSN 0908-1704



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ISBN 978-87-660-2 www

## PREFACE

Global demand for energy is growing. On an international scale, this trend impacts on energy prices as well as the reliability of supply.

In Denmark, we have been self-sufficient in energy for the past decade, mainly because of high Danish oil and gas production. However, the global situation still affects us in Denmark.

Therefore, future energy supplies as well as the climate and environment have become important issues on the political agenda, both nationally and internationally.

In February 2007, the Danish Government presented an energy strategy with a number of highly ambitious goals for Danish energy policy until 2025. By 2025, the Government's initiatives will have reduced Denmark's consumption of fossil fuels, such as coal, oil and natural gas, by 15 per cent, while the long-term goal is to eliminate Denmark's dependency on fossil fuels. The long-term strategy to defuse unstable energy prices is to use new, more efficient technologies. At the same time, reducing energy consumption will remain a focus area.

However, the Danish oil and gas sector will continue to have significant influence on the Danish economy and reliability of supply for many years ahead, particularly if we can exploit Danish resources even more effectively. To achieve this, we must maintain our commitment to the targeted research, education and training that will provide the best possible framework for technological development and exploration.

Strengthening research, education and training forms part of the efforts to meet the future requirements of Danish society, and in 2006 the Government launched an initiative to underpin these efforts. For this reason, the special section in this year's report deals with the subjects education, research and the future of the oil and gas sector.

Copenhagen, June 2007



Ib Larsen



*Star platform*

## CONVERSION FACTORS

### Reference pressure and temperature for the units mentioned:

		TEMP.	PRESSURE
Crude oil	m <sup>3</sup> (st)	15°C	101.325 kPa
	stb	60°F	14.73 psia <sup>ii</sup>
Natural gas	m <sup>3</sup> (st)	15°C	101.325 kPa
	Nm <sup>3</sup>	0°C	101.325 kPa
	scf	60°F	14.73 psia

ii) The reference pressure used in Denmark and in US Federal Leases and in a few states in the USA is 14.73 psia.

In the oil industry, two different systems of units are frequently used: SI units (metric units) and the so-called oil field units, which were originally introduced in the USA. The SI units are based on international definitions, whereas the use of oil field units may vary from one country to another, being defined by tradition.

The abbreviations used for oil field units are those recommended by the SPE (Society of Petroleum Engineers).

Quantities of oil and natural gas may be indicated by volume or energy content. As gas, and, to some extent, oil are compressible, the volume of a specific amount varies according to pressure and temperature. Therefore, measurements of volume are only unambiguous if the pressure and temperature are indicated.

The composition, and thus the calorific value, of crude oil and natural gas vary from field to field and with time. Therefore, the conversion factors for t and GJ are dependent on time. The table below shows the average for 2006 based on figures from refineries. The lower calorific value is indicated.

The SI prefixes m (milli), k (kilo), M (mega), G (giga), T (tera) and P (peta) stand for 10<sup>-3</sup>, 10<sup>3</sup>, 10<sup>6</sup>, 10<sup>9</sup>, 10<sup>12</sup> and 10<sup>15</sup>, respectively.

A somewhat special prefix is used for oil field units: M (roman numeral 1,000). Thus, the abbreviated form of one million stock tank barrels is 1 MMstb, and the abbreviation used for one billion standard cubic feet is 1 MMMscf or 1 Bscf.

### Some abbreviations:

kPa	kilopascal. Unit of pressure. 100 kPa = 1 bar.
Nm <sup>3</sup>	normal cubic metre. Unit of measurement used for natural gas in the reference state 0°C and 101.325 kPa.
m <sup>3</sup> (st)	standard cubic metre. Unit of measurement used for natural gas and crude oil in a reference state of 15°C and 101.325 kPa.
Btu	British Thermal Unit. Other thermal units are J (= Joule) and cal (calorie).
bbl	blue barrel. In the early days of the oil industry when oil was traded in physical barrels, different barrel sizes soon emerged. To avoid confusion, Standard Oil painted their standard-volume barrels blue.
kg · mol	kilogrammol; the mass of a substance whose mass in kilograms is equal to the molecular mass of the substance.
γ	gamma; relative density.
in	inch; British unit of length. 1 inch = 2.54 cm.
ft	foot/feet; British unit of length. 1 ft = 12 in.
t.o.e.	tons oil equivalent; this unit is internationally defined as 1 t.o.e. = 10 Gcal.

	FROM	TO	MULTIPLY BY
Crude oil	m <sup>3</sup> (st)	stb	6.293
	m <sup>3</sup> (st)	GJ	36.3
	m <sup>3</sup> (st)	t	0.86 <sup>i</sup>
Natural gas	Nm <sup>3</sup>	scf	37.2396
	Nm <sup>3</sup>	GJ	0.03954
	Nm <sup>3</sup>	t.o.e.	944.40 · 10 <sup>-6</sup>
	Nm <sup>3</sup>	kg · mol	0.0446158
	m <sup>3</sup> (st)	scf	35.3014
Units of volume	m <sup>3</sup> (st)	GJ	0.03748
	m <sup>3</sup> (st)	kg · mol	0.0422932
	m <sup>3</sup>	bbl	6.28981
	m <sup>3</sup>	ft <sup>3</sup>	35.31467
	US gallon	in <sup>3</sup>	231*
	bbl	US gallon	42*
Energy	t.o.e.	GJ	41.868*
	GJ	Btu	947817
	cal	J	4.1868*
Density	FROM	TO	CONVERSION
	°API	kg/m <sup>3</sup>	141364.33 / (°API + 131.5)
	°API	γ	141.5 / (°API + 131.5)

\*) Exact value

i) Average value for Danish fields

## CONTENTS



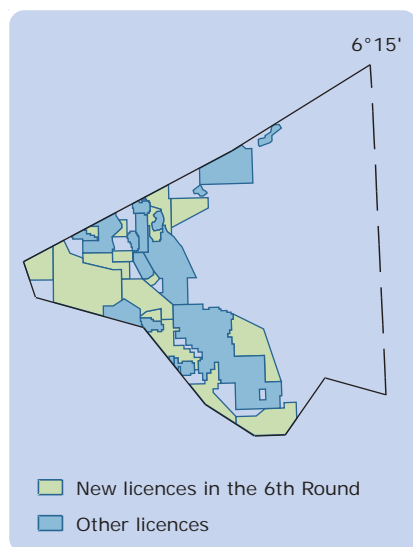
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## 1. LICENCES AND EXPLORATION

Fig. 1.1 New licences in the 6th Round



The award of 14 new licences in the 6th Licensing Round in 2006 means that extensive exploration activity can be expected in and around the Central Graben in the years to come.

In 2006, the DEA received three applications for areas in the rest of Denmark, which signals that interest in exploration continues outside the traditional areas. This interest also meant that the first onshore exploration well in more than 14 years was drilled, the Karlebo well in Northern Zealand.

### 6TH LICENSING ROUND

On 22 May 2006, the Minister for Transport and Energy awarded new licences for exploration and production of hydrocarbons. Danish and international oil companies showed great interest in the areas offered when the 6th Licensing Round was opened in spring 2005. The outcome of the 6th Licensing Round appears from Figure 1.1 and Appendix D3.

The 6th Round comprised all unlicensed areas west of 6°15' eastern longitude. In geological terms, the areas were located in the Central Graben, where most current Danish oil and gas production takes place, and in areas further towards the east in the Norwegian-Danish Basin and at the Ringkøbing-Fyn High.

The DEA received 17 applications for licences, and after assessing the applications and holding discussions with the applicants, the Minister for Transport and Energy awarded 14 licences for oil and gas exploration and production. The total area licensed in the western part of the Danish North Sea sector almost doubled as a result of the new licences. The location of the new licence areas and the composition of licensees appear from Appendix D3.

Combined, the work programmes for the 6th Round licences comprise seven firm wells, i.e. wells that the oil companies are obliged to drill. In addition, the work programmes provide for the drilling of 12 contingent wells, i.e. wells that are only to be drilled under specifically defined circumstances. The oil companies have also undertaken obligations to perform seismic surveys and a range of other investigations.

The DEA anticipates that exploration activities under the 14 new licences in the years ahead will represent a total cost of about DKK 2.5 billion.

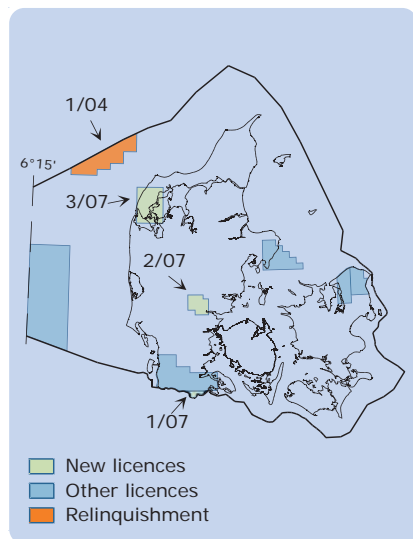
#### **The Danish North Sea Partner and the Danish North Sea Fund**

The Danish North Sea Partner is a state-owned entity administering the Danish North Sea Fund. The Danish North Sea Fund and the Danish North Sea Partner were set up under a new Act passed in 2005. The Fund is an independent foundation that is to defray the expenditure and receive the revenue associated with the new licences.

The Fund will be in charge of the state's 20 per cent share of all new licences, both Open Door licences and licences granted in connection with licensing rounds. Previously, DONG E&P A/S was in charge of state participation.

From 9 July 2012, the Fund will also be responsible for the 20 per cent state participation in DUC, Dansk Undergrunds Consortium.

Fig. 1.2 New and relinquished Open Door licences



In the 6th Licensing Round, licences were granted to several oil companies not previously holding licences in Denmark. At the same time, the companies Wintershall, Altinex, GeysirPetroleum and Scotsdale, which have not previously been operators in Danish territory, have been approved as operators for some of the new licences.

### OPEN DOOR AREA

In 2006, the DEA received a total of three applications for licences in the Open Door area.

The DEA received an application for an area in southern Jutland and surrounding waters on 14 August 2006. The applicant was Geo-Center-Nord GmbH. This company also holds a share of a German licence due south of the above-mentioned area, but has not previously held licence shares in Danish territory.

On 22 September 2006, the DEA received an application for an area northwest of Vejle. The applicant was Jordan Dansk Corporation, an oil company incorporated in the USA. This company also held a share in a licence granted for the same area in the 3rd Licensing Round.

In addition, the DEA received an application for an area in northwestern Jutland from DONG E&P A/S on 29 September 2006.

On 12 February 2007, the Minister for Transport and Energy granted all three applicants licences for hydrocarbon exploration and production in the areas applied for; see Figure 1.2.

#### Open Door procedure

In 1997, an Open Door procedure was introduced for all unlicensed areas east of 6° 15' eastern longitude, i.e. the entire Danish onshore and offshore areas with the exception of the western part of the North Sea.

The procedure applies to areas in which no commercial oil or gas discoveries have so far been made. The conditions for granting licences in the Open Door area are therefore more lenient than in the western part of the North Sea, which is subject to a licensing round procedure. Oil companies can continually apply for licences in the Open Door area within an annual application period from 2 January through 30 September.

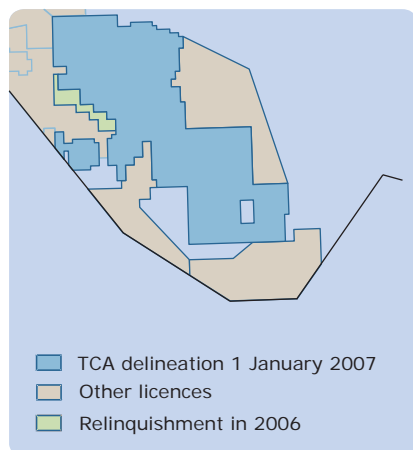
A map of the area and a letter inviting applications for Open Door areas are available at the DEA's website, [www.ens.dk](http://www.ens.dk).

### RELINQUISHMENT IN THE CONTIGUOUS AREA

The Sole Concession, granted to A.P. Møller in 1962, includes the Contiguous Area in the southern part of the Central Graben.

In 1981, the Danish state and A.P. Møller entered into an agreement according to which the Concessionaires were to relinquish 25 per cent of each of the nine sixteenth blocks making up the Contiguous Area, the areas being relinquished as of 1 January 2000 and again as of 1 January 2005. Areas that comprise producing fields and areas for which development plans have been submitted are exempt from relinquishment.

Fig. 1.3 Relinquishment in the Contiguous Area (TCA)



The area relinquishment as of 1 January 2005 comprised 25 per cent of two blocks. One individual area (area I) was subject to considerable geological uncertainty. Therefore, the area could not ultimately be delineated at the time the agreement was concluded. The Concessionaires decided, after making additional assessments, to relinquish area I at the end of 2006.

The revised extent of the Contiguous Area and the relinquished area appear from Figure 1.3. The new delineation and new field delineation for Valdemar, Roar and Tyra are shown in Figure 2.1 in the section *Development and production*.

On 29 September 2003, the Minister for Economic and Business Affairs and A. P. Møller entered into an agreement termed the North Sea Agreement. This agreement means that the Concessionaires may retain the remaining area comprised by the Sole Concession until its expiry in 2042. However, areas in which production is discontinued must be relinquished to the state.

### AMENDED LICENCES

The outline of licences at the DEA's website, [www.ens.dk](http://www.ens.dk), is continually updated and describes all amendments in the form of extended licence terms, the transfer of licence shares and relinquishments.

#### Approved transfers

All contemplated transfers of licences and the relevant transfer conditions must be submitted to the DEA for approval.

The DEA approved the transfer of Elko Energy Inc.'s share of licence 2/05 to Arkay A/S, a Danish subsidiary of Elko Energy Inc. The transfer became effective on 13 March 2006.

The DEA also approved the transfer of 5 per cent of ConocoPhillips Petroleum Int. Corp. Denmark's share of licence 4/98 to Saga Petroleum Danmark AS. The transfer became effective on 1 January 2006.

Further, the DEA approved the transfer of Tethys Oil Denmark AB's 20 per cent interest in licences 1/02 and 1/03 to Star Energy. The transfer became effective on 18 August 2006.

#### Conditions of licences

Licences for the exploration for and production of hydrocarbons are granted for a six-year term. Each licence includes a work programme specifying the exploration work that the licensee must carry out, including time limits for conducting the individual seismic surveys and drilling exploration wells. However, some licences may stipulate that the licensee is obligated to carry out specific work, such as the drilling of an exploration well, or to relinquish the licence by a certain date during the six-year term of the licence.

After the six-year term, the DEA may extend the term of a licence by up to two years at a time, provided that the licensee, upon carrying out the original work programme, is prepared to undertake additional exploration commitments.



Fig. 1.4 Annual seismic activities

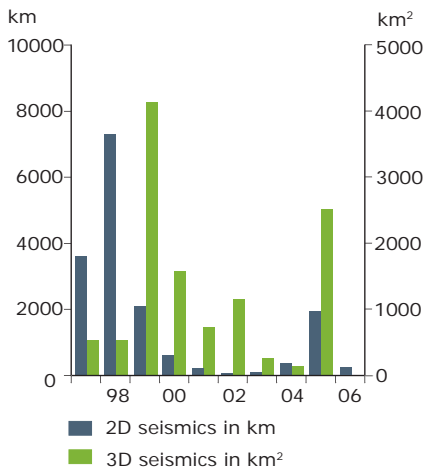


Table 1.1 Terminated licence

Licence	Operator	Terminated
1/04	DONG E&P A/S	3-11-2006

Effective 5 September 2006, Altinex took over DENERCO OIL. In connection with the takeover, the name DENERCO OIL A/S was changed to Altinex Oil Denmark A/S, and the name DENERCO Petroleum A/S was changed to Altinex Petroleum Denmark A/S.

**TERMINATED LICENCES**

In 2006, a licence in the Open Door area was relinquished. The relinquished licence 1/04 appears from Table 1.1 and Figure 1.2.

Generally, data that companies compile under licences granted in pursuance of the Subsoil Act is protected by a five-year confidentiality clause. However, the confidentiality period is limited to two years if the licence has expired or been relinquished.

When the confidentiality period has expired, other oil companies are given access to the data acquired from exploration wells and seismic surveys. This allows the companies to improve their mapping of the subsoil and their assessments of exploration potential in the relevant areas.

All information about released well data, including seismic surveying data, etc. acquired in connection with exploration and production activities, is provided by the Geological Survey of Denmark and Greenland.

**EXPLORATORY SURVEYS**

The level of activity and the areas where seismic surveys were performed appear from Figures 1.4, 1.6 and 1.7. The level of seismic data acquisition was lower in 2006 than in

**Seismic surveys**

Seismic surveys are carried out by sending pressure waves into the subsoil. When the pressure wave encounters different geological layers in the subsoil, part of the pressure wave is reflected back to the surface. An analysis of the pressure waves reflected produces a picture of the geological structures in the subsoil.

When seismic data is acquired from a vessel, the pressure wave travels from the vessel into the subsoil.

A 2D seismic survey provides a vertical cross-section of the subsoil. If the 2D seismic surveys are closely spaced, they also provide a spatial understanding of the geological structures, which is called a 3D seismic survey.

Large areas of the Danish part of the Central Graben are covered by 3D seismic surveys. A comparison between 3D seismic data acquired for the same area at several-year intervals yields a fourth dimension: time.

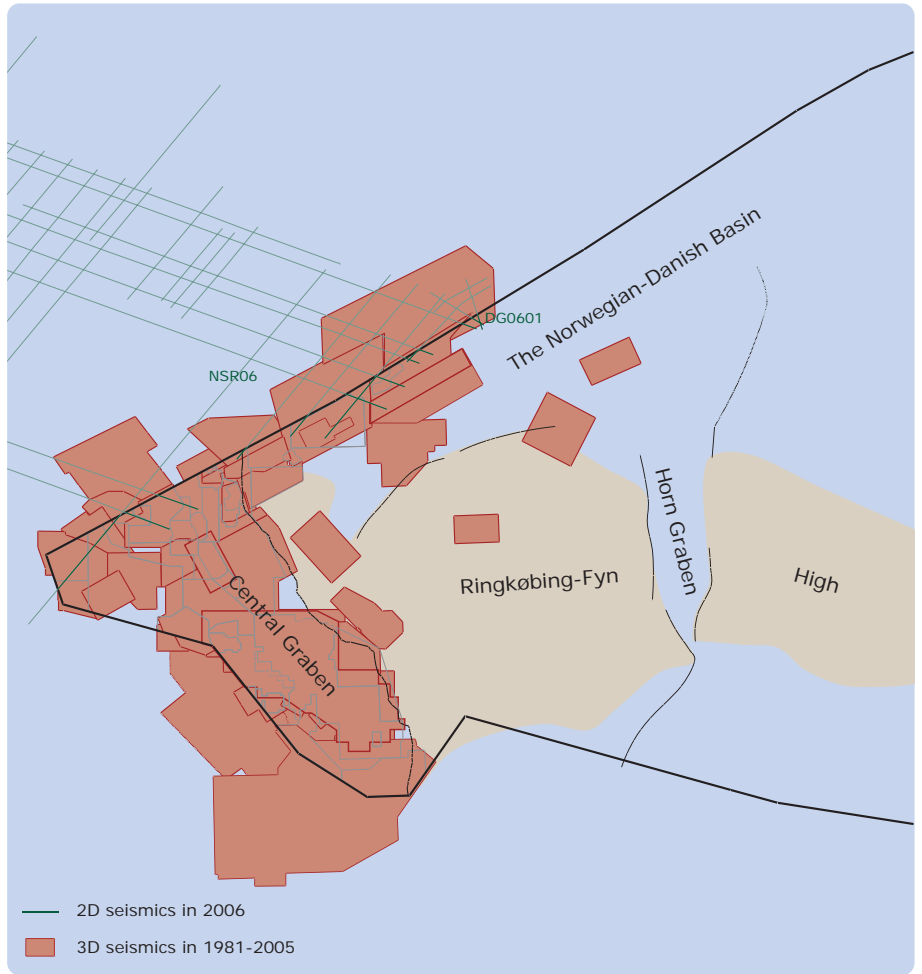
4D seismic data can provide insight into the changes occurring in a producing field over time. For one thing, 4D seismic data can show the direction of hydrocarbon flow towards the wells and the location of any remaining hydrocarbon pockets. This information helps optimize recovery.

The companies acquiring seismic data must plan the surveys so as to ensure minimum disturbance of animal life. The seismic programmes are subject to the DEA’s approval.

Fig. 1.6 Seismic survey in the Open Door area

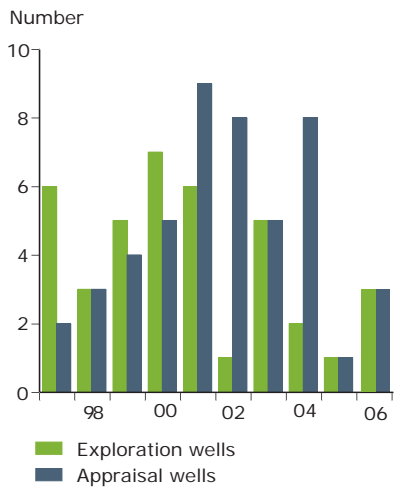


Fig. 1.7 Seismic surveys west of 6°15' eastern longitude



2005. The high level in 2005 was due to the fact that Mærsk Olie og Gas AS conducted an extensive 3D seismic survey of the Contiguous Area in 2005. The work programmes to be implemented as a result of the 6th Licensing Round imply that the level of activity will increase in the years ahead.

Fig. 1.5 Exploration and appraisal wells



During the period from 22 to 25 October 2006, Geo-Center-Nord GmbH carried out a 2D seismic survey in Flensburg Fjord. The University of Hamburg was in charge of the survey.

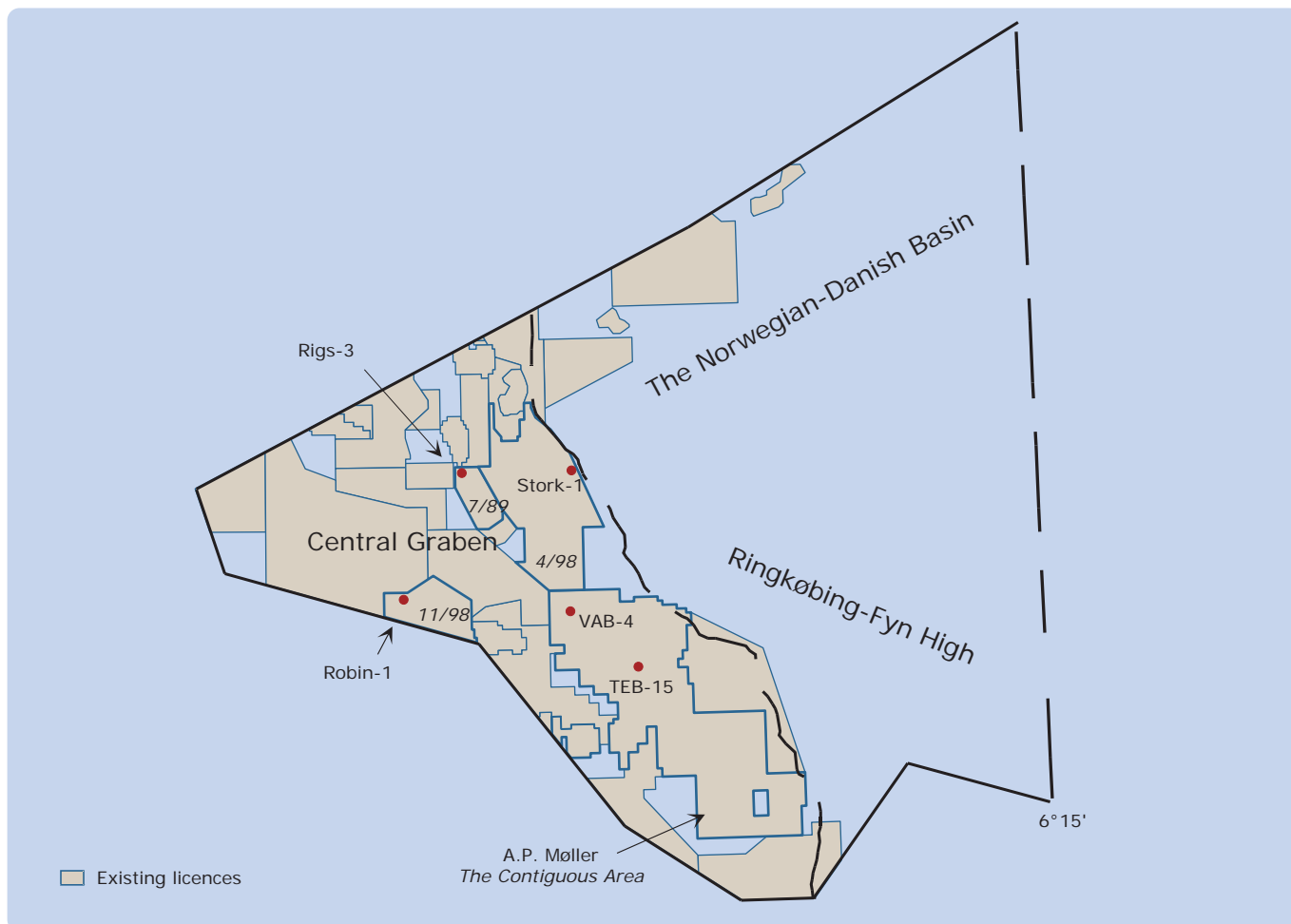
In 2006, TGS Nopec carried out a 2D seismic survey in the North Sea. The main part of the survey took place in Norwegian and UK territory, but several seismic lines were extended into Danish territory.

In July 2006, DONG Norge AS carried out a 2D seismic survey in Norwegian territory, extending a few of the seismic lines into Danish territory. Fugro Survey Ltd was in charge of seismic data acquisition.

**WELLS**

In 2006, three exploration wells and three appraisal wells were drilled; see Figure 1.5. The location of the wells described below appears from Figures 1.8 and 1.9. The

Fig. 1.8 Exploration and appraisal wells in 2006 west of 6°15' eastern longitude



appraisal wells drilled in the producing fields are also shown in the field maps in Appendix B.

An outline of all Danish exploration and appraisal wells is available at the DEA's website, [www.ens.dk](http://www.ens.dk).

**Exploration wells**

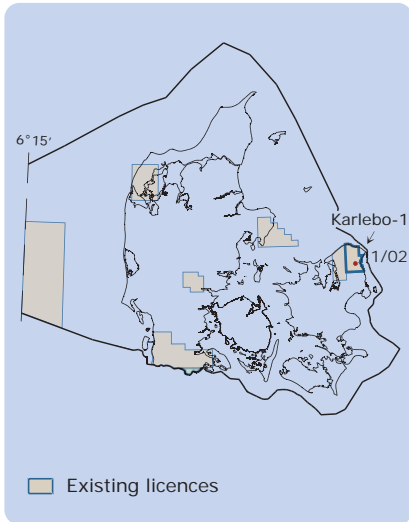
*Robin-1 (5503/08-01)*

As the operator for the companies holding licence 11/98, DONG E&P A/S drilled the Robin-1 (5503/08-01) exploration well. The well, which was spudded on 7 June 2006, was located about 6 km north of the German A6/B4 gas field. The Robin-1 well was drilled as a slightly deviated well, terminating at a depth of 3,458 metres in layers of Triassic age. The well encountered a sandstone reservoir in Triassic layers and porous chalk in Upper Cretaceous layers. The well encountered only minor traces of hydrocarbons.

*Stork-1 (5604/31-01)*

The operator for the holders of licence 4/98, ConocoPhillips Petroleum Int. Corp. Denmark, drilled the Stork-1 (5604/31-01) exploration well. The Stork-1 well was drilled as a slightly deviated well and terminated in volcanic rock at a depth of 4,880

Fig. 1.9 Exploration and appraisal wells in the Open Door area



metres. The well encountered a hydrocarbon-bearing Jurassic sandstone layer. No production test was conducted. The results from the well are to be evaluated more closely.

#### *Karlebo-1 (5512/02-01)*

Tethys Oil Denmark AB, the operator for the holders of licence 1/02, was responsible for drilling the Karlebo-1 (5512/2-01) exploration well in northeastern Zealand. The drilling was carried out during the period from September to November 2006. The Karlebo-1 well was drilled as a deviated well and terminated in Triassic rock at a depth of 2,302 metres. The well encountered Lower Cretaceous and Triassic sandstone. The well discovered no oil or gas.

#### **Appraisal wells**

##### *TEB-15A-B (5504/12-13)*

In May 2006, Mærsk Olie og Gas AS finished drilling the TEB-15 appraisal well, which was drilled from the Tyra Field towards Tyra Southeast. The well was drilled as a combined production and appraisal well. Two sidetracks were drilled, one to evaluate the thickness of the Danian reservoir and one to test the potential of the underlying Maastrichtian reservoir. TEB-15B terminated in the Danian gas reservoir and was converted to production in May 2006.

##### *VAB-4 (5504/07-13)*

In connection with the development of the Valdemar Field, Mærsk Olie og Gas AS finished drilling the VAB-4 well in April 2006. During the drilling operation, a sidetrack was drilled to investigate the reservoir properties in the Lower Cretaceous reservoir. Subsequently, the VAB-4 well was completed as a horizontal production well.

##### *Rigs-3 (5604/29-08)*

As the operator for the oil companies holding licence 7/89, Hess Denmark ApS drilled the Rigs-3 (5604/29-08) appraisal well in the South Arne Field. This well was to appraise the Upper Cretaceous and Danian potential. The drilling operation was carried out in cooperation with DONG E&P A/S during the period from March to April 2006. Rigs-3 was drilled as a vertical well about 4.5 km northwest of the South Arne platform. The well terminated at a depth of 3,156 metres in Lower Cretaceous chalk. Moreover, a total of three sidetracks were drilled into areas west, north and east of the surface location. Rigs-3 and the three sidetracks encountered the presence of oil and gas in chalk layers and thus confirmed the geological model for the area. The results are now being evaluated more closely.

## 2. DEVELOPMENT AND PRODUCTION

Overall, activity in the Danish oil and gas industry was high throughout 2006, particularly due to the high price of oil in recent years. Consequently, special attention was focused on optimizing production and further developing existing fields.

### PRODUCTION IN 2006

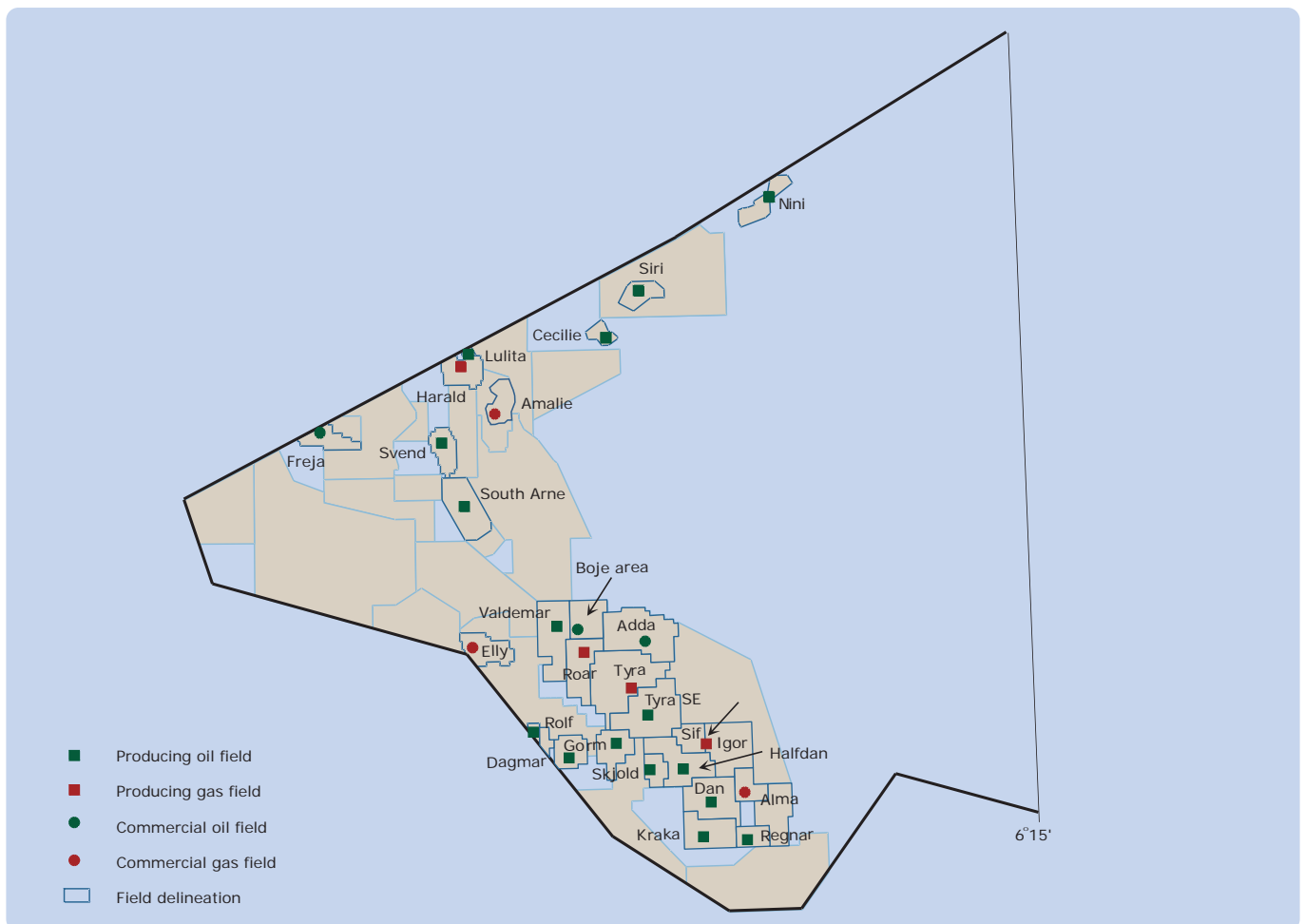
In 2006, the number of producing fields in the Danish sector of the North Sea totalled 19. Mærsk Olie og Gas AS is the operator for 15 fields, DONG E&P A/S for three fields and Hess Denmark ApS for one field. Figure 2.1 shows a map of the producing fields.

A total of ten companies have interests in the licences that generated oil and gas production in 2006. Figure 2.2 shows the individual companies' share of production.

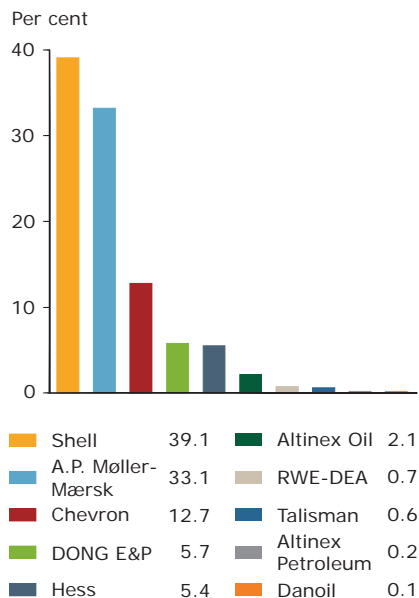
Danish oil production amounted to 19.8 million m<sup>3</sup> in 2006, a decline of about 9 per cent compared to the previous year and about 12 per cent compared to the record year 2004. Figure 2.3 shows the historical development of Danish oil production since 1972, when production started.

A fourth of the production decline in 2006 was due to substantially lower production figures from DUC's fields in September, when a planned shutdown associated with workover at the Gorm facilities was extended. Stagnating production from several of the major and older fields accounted for the remaining three-fourths of the decline.

Fig. 2.1 Danish oil and gas fields



**Fig. 2.2** Breakdown of oil production by company



Danish oil production estimates for the years to come indicate that production from a number of the developed fields will show a declining trend. If oil production is to remain at the current level, investments in further field developments and improved recovery methods are required.

Figure 2.4 compares historical oil production with the development in the total number of wells. The figure clearly shows that introducing horizontal wells and water injection helped increase production from the mid-1980s onwards. The sharp rise in production in 1999 was primarily attributable to the commissioning of the Halfdan and South Arne Fields.

In 2006, a total of 378 wells contributed to production, 263 of which were production wells and 115 injection wells. Of the 263 production wells, 207 produced oil and 56 produced gas. A total of 101 wells were used as water injectors and 14 as gas injectors.

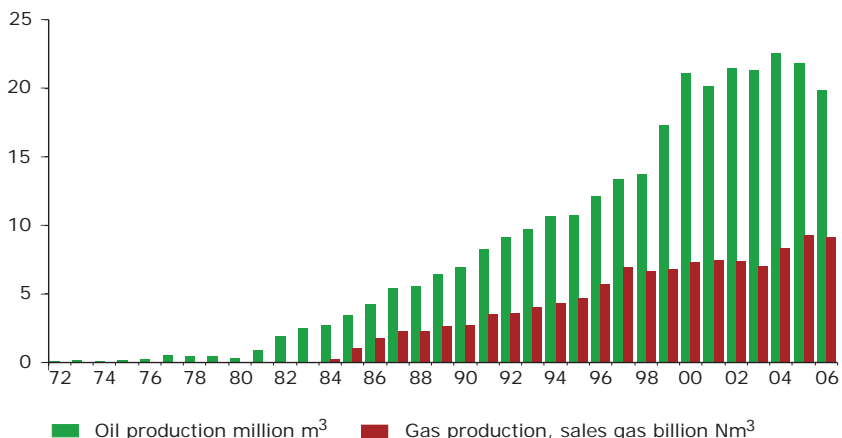
Natural gas production totalled 10.9 billion Nm<sup>3</sup> in 2006. Sales gas amounted to 9.2 billion Nm<sup>3</sup>, on a par with the record sales gas figure in 2005. The remainder of the gas produced was injected into selected fields to improve recovery or was used as fuel on the platforms. Moreover, a small volume of gas was flared for technical and safety reasons. Figure 2.3 shows the historical development in sales gas production. The section *The environment* contains an outline of fuel consumption and gas flaring offshore.

The injection of gas fell for the third year in a row. In 2006, 0.83 billion Nm<sup>3</sup> of gas was injected against 1.43 billion Nm<sup>3</sup> of gas in 2005. Injection into the Tyra Field, in particular, was reduced.

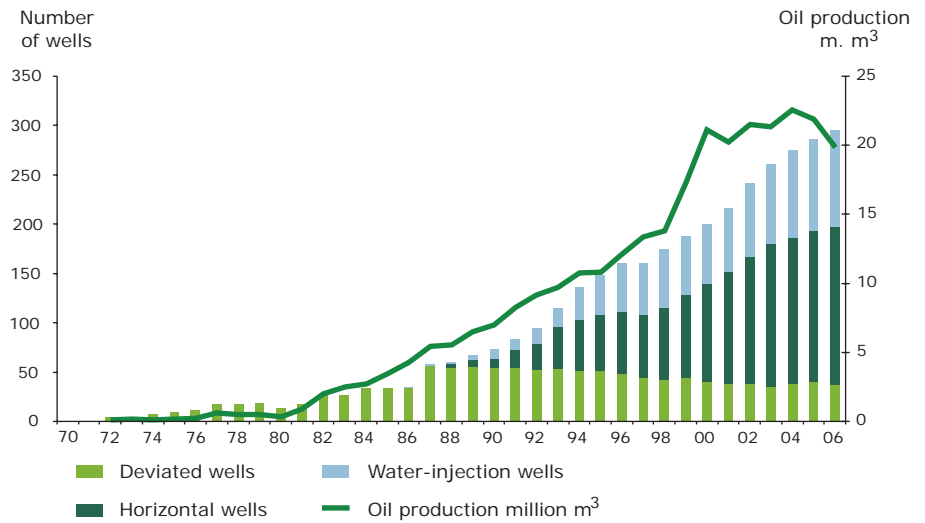
Figure 2.5 shows existing production facilities in the Danish sector of the North Sea at the beginning of 2007.

Appendix A shows figures for the production of oil and gas from the individual fields. Gas production is broken down into sales gas, injection gas, fuel gas and flared gas. Moreover, Appendix A contains figures for the production and injection of water as well as for CO<sub>2</sub> emissions. Annual production figures since the startup of production in 1972 are available at the DEA's website, [www.ens.dk](http://www.ens.dk).

**Fig. 2.3** Production of oil and gas



**Fig. 2.4** Historical development in well technology compared with oil production



**PRODUCING FIELDS**

In 2006, the DEA approved eight applications to develop existing fields, twice the number received the year before. No applications for the development of new fields were submitted in 2006.

These eight approved development plans represent total investments of almost DKK 5.6 billion for the years ahead. In 2006, DKK 5.6 billion was invested in field development, a DKK 1.7 billion increase on 2005.

Development plans approved in previous years are being implemented on an ongoing basis, and 20 new wells were drilled in 2006 as part of these plans. Information about approved development plans and plans under consideration is available at the DEA’s website, [www.ens.dk](http://www.ens.dk).

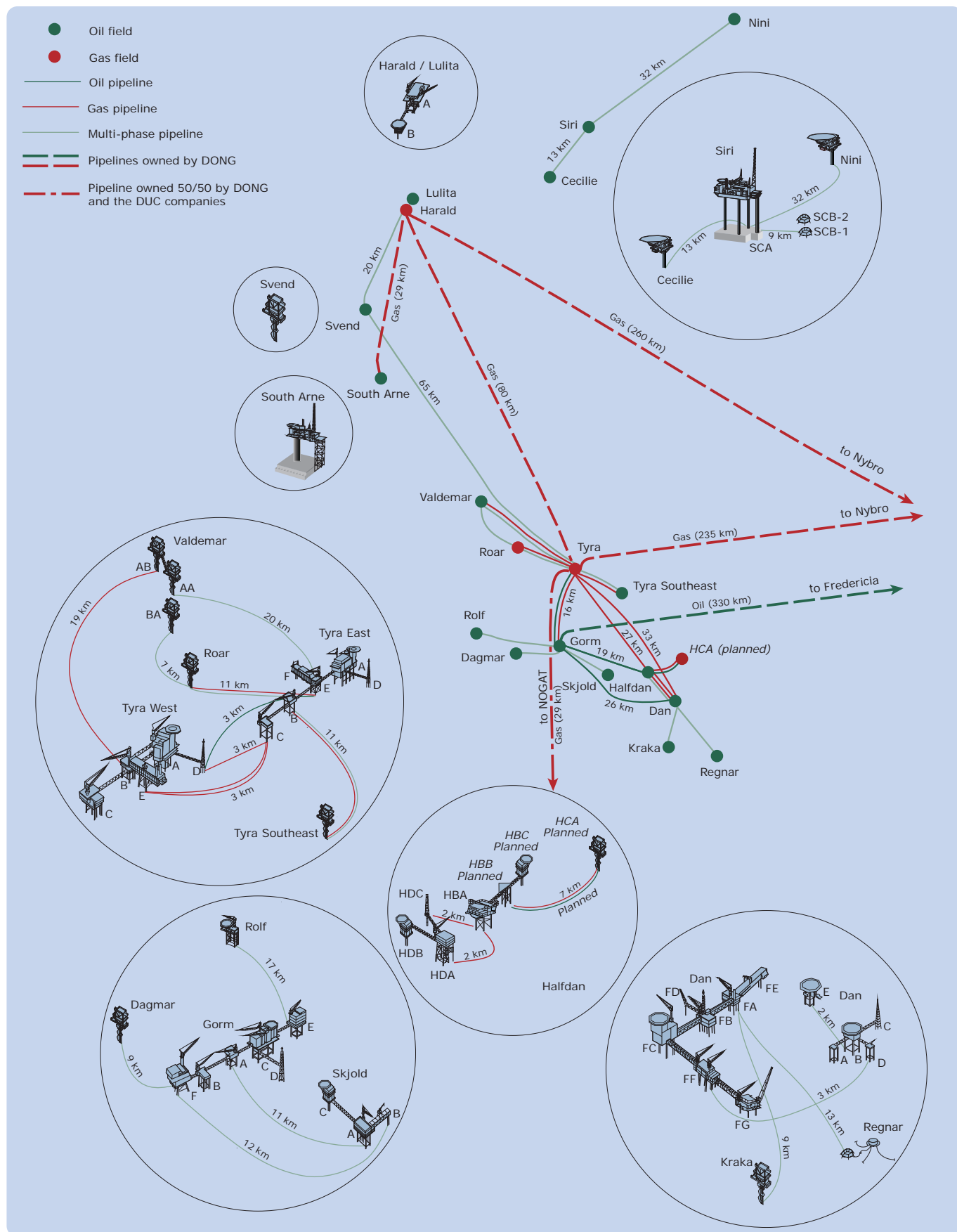
The high price of oil has generally engendered brisk activity in oil field development worldwide. Consequently, the demand for drilling rigs, drilling equipment and personnel to drill new wells has risen, resulting in long waiting periods and, on occasion, delays in development activities at oil fields all over the world. In Denmark, the scarcity of drilling rigs has delayed the drilling of new wells, another reason for the decline in production in 2006.

The current development and production status for all Danish producing fields is described below. Appendix B contains a detailed outline of producing fields, including various facts about each individual field.

**The Cecilie Field (DONG)**

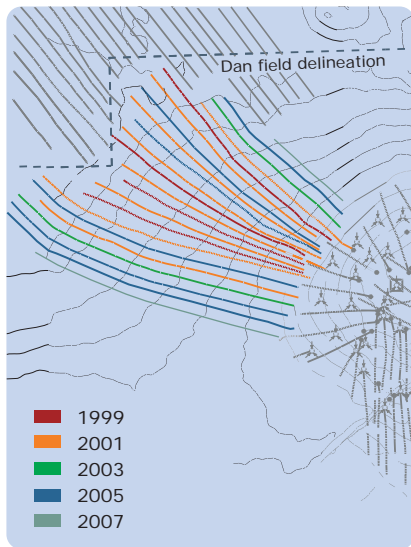
The Cecilie Field has three oil production wells and one water-injection well, all horizontal. No development activity occurred at the Cecilie Field in 2006. The newest well in the field was drilled in 2004.

Fig. 2.5 Production facilities in the North Sea 2006





**Fig. 2.6** Development phases of the Dan Western Flank from 1999-2007



### The Dagmar Field (Mærsk)

At the end of 2006, the drilling rig Maersk Enhancer drilled a horizontal appraisal and production well, Dagmar 8, in the Dagmar Field. The well results did not, however, confirm a new model for the field, for which reason the well was plugged and abandoned. In 2004, the two remaining oil production wells in the field recorded a heavy increase in associated gas production. In 2005, these wells were closed in. At the beginning of 2007, the Dagmar Field was not carrying on production, and its future has yet to be determined.

### The Dan Field (Mærsk)

In 2006, the drilling rig Ensco 71 drilled two new horizontal oil production wells at the western flank of the Dan Field, MFB-2G and MFF-9B, which have both been brought on stream.

One well, MFF-2, was plugged and abandoned, and three wells, MFA-13B, MFF-27E and ME-5, were converted from oil production to water injection. Thus, at the end of 2006, the Dan Field had a total of 56 oil production wells and 50 water-injection wells.

Moreover, plans for further developing the western flank were approved in 2006. The development plan provides for extending the existing well pattern with two or three new production wells and converting an existing production well to water injection. A new well module for eight wells has been installed at the existing Dan FF platform, now able to accommodate a total of 40 wells. Figure 2.6 shows the phased development of the western flank of the Dan Field.

In 2006, production continued the declining trend of recent years. Production from the field peaked in 2000.

### The Gorm Field (Mærsk)

In 2006, the drilling rig Noble Byron Welliver drilled four horizontal wells for oil production at the Gorm Field, N-59A, N-60A, N-61C and N-9A. The N-9A well was a redrill of the existing N-9 well.

The new wells were drilled to restrain the decline in the field's oil production.

At the end of 2006, the Gorm Field had a total of 36 oil production wells, 14 water-injection wells and two gas-injection wells.

A number of minor defects were ascertained during the routine inspection and maintenance of the Gorm facilities. As a result, a planned shutdown of the facilities had to be extended by eight days to a total of 13 days. The shutdown put the entire installation out of operation, and the unusually long shutdown period reduced production from the Gorm Field and the adjoining satellite fields, Rolf and Skjold.

### The Halfdan Field (Mærsk)

Most of the wells in the Halfdan Field are symmetrically placed in an alternating pattern of oil production and water-injection wells, with parallel well trajectories. In 2006, the development of the field meant that six new wells were drilled, three oil production wells and one gas production well plus two water-injection wells that are producing oil before injection starts.



*The Halfdan Field*

One of the new oil production wells, HBA-17, was brought on stream at the beginning of 2006. This well is covered by the same application as the neighbouring well, HBA-21, with a parallel well trajectory, drilled in 2005. Since having a water-injection well on the edge of the well pattern is inexpedient, HBA-21 served as a production well until HBA-17 was ready for production. HBA-21 has now been converted to water injection.

Another two pairs of injection and production wells were completed in the third quarter of 2006, HBA-22 and HBA-23 as well as HBA-25 and HBA-30. These wells met production targets, for which reason the DEA approved a supplementary development plan in 2006, which provided for the drilling of two wells, HBA-26 and HBA-29 at the beginning of 2007. The drilling rig Mærsk Endeavour has been permanently located at the HBA platform since the end of 2004.

A further plan for exploiting the gas accumulation in the northeastern part of the Halfdan Field was approved in 2006. This plan provides for five gas production wells to be drilled from a new wellhead platform, HCA, with capacity for ten wells, and two gas production wells to be drilled as part of the existing pattern of gas production wells. One of these wells was drilled in 2006.

The HCA platform will be located about 7 km northeast of the existing Halfdan HBA platform. In addition, a new accommodation platform and a new riser platform will be established, both to be connected by bridges to the HBA platform.

Increased recovery from the northeastern part of the Halfdan Field has led to a planned reconstruction of the Tyra West platform facilities, where gas production is processed.

At the end of 2006, the Halfdan Field had 27 oil production wells, 23 water-injection wells and seven gas production wells.

#### **The Harald Field (Mærsk)**

The Harald Field has a total of four gas production wells. In 2006, permission was granted for the drilling of a new gas production well in the field. According to the plan, the well will penetrate Jurassic layers to investigate a new production target in the eastern part of the Harald Field.

To date, only gas has been produced from the chalk layers in this part of the field, but the Jurassic layers may contain both oil and gas. If oil is discovered, oil production from the field is expected to increase by about 1.4 million m<sup>3</sup> of oil in total, and if gas is discovered, gas production from the field is expected to increase by about 1.9 billion Nm<sup>3</sup> of gas in total.

#### **The Kraka Field (Mærsk)**

The Kraka Field has a total of seven wells, all producing oil. No development activity occurred at the Kraka Field in 2006. In 2006, a development plan was approved for the Kraka Field, of which the first phase provides for the drilling of a horizontal production well with two laterals. The plan is to drill the well as a redrill of an existing well, A-4. The well is scheduled for drilling at the beginning of 2008.

#### **The Lulita Field (Mærsk)**

In 2006, there was no development activity at the Lulita Field, which has two oil production wells, although only one is producing oil at present.

### **Can we store oil for future generations?**

At present, the Danish state is more than self-sufficient in oil and gas, which makes Denmark a net exporter. So the natural question arises, can some of the resources be stored for future generations?

The resources in the Danish subsoil belong to the state. When oil companies are awarded exploration and production licences in parts of Danish territory, they repay a percentage of the value of oil and gas produced to the Danish state through taxes and fees.

Denmark started producing oil in 1972 and gas in 1984. As the volume of production increased, the production apparatus was extended in the form of platforms and processing facilities. At the same time, a pipeline system was established to transport oil and gas from platform to platform and from platform to shore. All these facilities are designed to have a certain life span, which can be extended for a period of time, albeit with steadily increasing maintenance costs.

From an international perspective, Danish oil and gas deposits are small. Consequently, only the largest deposits can shoulder the heavy investments in production facilities on their own. Smaller deposits have to be hooked up to the existing infrastructure if they are to be exploited.

If a producing field is closed down to store the remaining oil for future use, the wells, facilities and platforms will require continued maintenance during the closedown period. Another solution is to invest in new field development when production is to resume. However, the infrastructure needed to resume production might be unavailable. The remaining oil-in-place in existing Danish fields would be unable to support major new investments.

In addition to the problems relating to facilities, financial considerations affect the decision whether to store oil and gas resources for future use. Experience has shown that reinvesting the proceeds from oil and gas production yields a higher return than postponing production.

Therefore, it does not pay – either for Danish society or for the oil companies – to store some of the oil and gas resources for future generations.

### **The Nini Field (DONG)**

The Nini Field has a total of five oil production wells and two water-injection wells.

A development plan providing for the drilling of a horizontal oil production well to the Ty reservoir in the Nini Field was approved in 2006. The well is scheduled to be drilled in 2007 from the existing platform at the Nini Field. Depending on the results from this well, a second phase will be initiated, providing for an additional production well and/or one water-injection well.

**The Regnar Field (Mærsk)**

The Regnar Field has a deviated oil production well, which began producing in 1993. The current production rate is low, combined with a high water production rate. No development activity occurred at the Regnar Field in 2006.

**The Roar Field (Mærsk)**

The Roar Field has a total of four gas production wells. A new multiphase pipeline has been established from the Valdemar BA platform to Tyra East, via the Roar Field. At the beginning of March 2007, the Roar Field was hooked up to the new pipeline. The old pipeline has been decommissioned.

**The Rolf Field (Mærsk)**

The Rolf Field has a total of two oil production wells. In 2006, stable production was achieved from the field, but with high water content. There was no development activity at the Rolf Field in 2006.

**The Siri Field (DONG)**

In 2006, permission was granted to develop the Siri Field further with an updated well pattern. The plan is to drill four oil production wells, of which three are to be drilled as sidetracks of existing wells. Two of these wells, SCA-3A and SCA-11A, were made ready for drilling sidetracks in autumn 2006. At the end of 2006, the Siri Field had a total of eight oil production wells, two water-injection wells and one gas-injection well.

**The Skjold Field (Mærsk)**

The Skjold Field has a total of 19 oil production wells and nine water-injection wells. The first well came on stream in 1982. In 2006, stable production was achieved, but with high water content. No development activity occurred at the Skjold Field in 2006.

**The South Arne Field (Hess)**

The South Arne Field has a total of 11 oil production wells and six water-injection wells. There was no development activity at the South Arne Field in 2006, but the Rigs-3 appraisal well was drilled. Production from the existing development is stagnating. A further development with new wells is expected to sustain the production level.

**The Svend Field (Mærsk)**

The Svend Field has a total of four oil production wells, whose production is stable. There was no development activity at the Svend Field in 2006. The field carries on production without pressure support from water injection.

**The Tyra Field (Mærsk)**

In the Tyra Field, the drilling rigs Nobel Byron Welliver and Rowan Gorilla VII drilled four new wells, all producing gas, in 2006. The field has a total of 19 gas production wells, 28 production wells (oil and gas) and 20 gas production wells, which can also be used to inject gas.

**The Tyra Southeast Field (Mærsk)**

No development activity occurred at the Tyra Southeast Field in 2006. At the end of the year, the field had five oil production and two gas production wells.



*The drilling rig Nobel Byron Welliver*

In 2006, the DEA received a plan for major development of the Tyra Southeast Field. Subsequently, separate applications have been submitted for parts of this plan, requesting permission to replace two low-performing existing oil production wells with two new gas production wells, one of which will have dual laterals draining the reservoir. These applications have been approved, and the wells are to be drilled in the first half of 2007.

#### **What happens to disused oil and gas installations?**

In the Danish sector of the North Sea, there are currently 48 steel platforms and five subsea installations placed on the seabed. In addition, there is about 1,700 km of pipelines, ranging from 1" to 42" in diameter.

When a field closes down, the operator has to draw up a plan describing the decommissioning and disposal of wells, platforms and pipelines. The DEA and the Danish Environmental Protection Agency are to approve the plan based on their overall assessment of resource management, safety and environmental issues.

To date, no fields have been closed down in Danish territory, but the need may arise in the not too distant future. Production from a field will be discontinued when the operating and maintenance costs exceed income from production.

#### **Removal of steel platforms**

As part of the international cooperation taking place under the auspices of OSPAR, Denmark and the other North Sea countries have decided that all oil and gas installations with a jacket weighing less than 10,000 tons are to be removed from the seabed. The installations are to be transported to shore and scrapped. This means that all disused steel platforms in the Danish continental shelf area are to be removed.

In addition, the UN International Maritime Organisation (IMO) has adopted guidelines and standards for removing offshore installations. These provisions are less restrictive than the OSPAR Convention, and low water depths make them inapplicable in Danish territory.

Some of the existing platforms have been designed for removal and reuse at new locations.

#### **Removal of pipelines**

After assessing the issues involved, the DEA may demand to have pipelines removed. There are no international guidelines or standards for the removal of pipelines.

The majority of Danish pipelines have been buried ½ to 1 metre down in the seabed. The DEA does not expect that pipelines buried in the seabed will have to be removed. However, disused pipelines not buried in the seabed will most likely have to be removed or buried in the seabed. An abandoned pipeline is expected to corrode away in the course of about 100 years.

The remaining part of the plan provides for the installation of new pipelines and a new platform as well as the drilling of oil production wells and water-injection wells. The operator wishes to optimize the development plan on the basis of the results from the accelerated gas production wells and a planned appraisal well at the Halfdan Field. For this reason, the DEA has postponed considering the plan until the operator has evaluated this information.

**The Valdemar Field - Bo and North Jens (Mærsk)**

The drilling rig Maersk Exerter was permanently located at the VAB platform throughout 2006. During that period, three wells were drilled into the Lower Cretaceous reservoir of the North Jens structure in the Valdemar Field. The development plan approved in 2004 includes the drilling of eight wells.

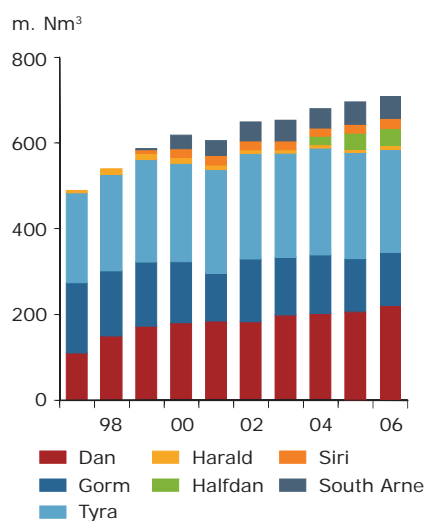
In July 2006, the VBA platform was installed at the Bo structure of the Valdemar Field about 3.5 km south of the VAB platform. A 16" multiphase pipeline connecting Valdemar to the Tyra East facilities, via the Roar Field, was also installed in 2006. The platform commissioning and pipeline hookup are scheduled for the beginning of 2007.

The drilling rig Nobel Byron Welliver arrived at the platform in December 2006 to begin drilling a gas production well into the Upper Cretaceous reservoir. The five remaining approved wells are to be drilled into the Lower Cretaceous reservoir in 2007 and 2008. Another four wells may be drilled, depending on the results produced by those already planned.

At the end of 2006, the Valdemar Field had 11 oil-producing wells.

### 3. THE ENVIRONMENT

Fig. 3.1 Fuel consumption



The production of oil and gas from Danish offshore installations results in emissions to the atmosphere, including the gases CO<sub>2</sub> and NO<sub>x</sub>, as well as discharges into the sea consisting of chemicals and oil residue.

#### EMISSIONS TO THE ATMOSPHERE

The combustion and flaring of oil and natural gas produce CO<sub>2</sub> emissions to the atmosphere. Producing and transporting oil and gas require substantial amounts of energy. Furthermore, a considerable volume of gas that cannot be utilized for safety or plant-related reasons has to be flared.

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

The Danish Subsoil Act regulates the volumes flared and consumed as fuel, while CO<sub>2</sub> emissions are regulated by the Act on CO<sub>2</sub> Allowances.

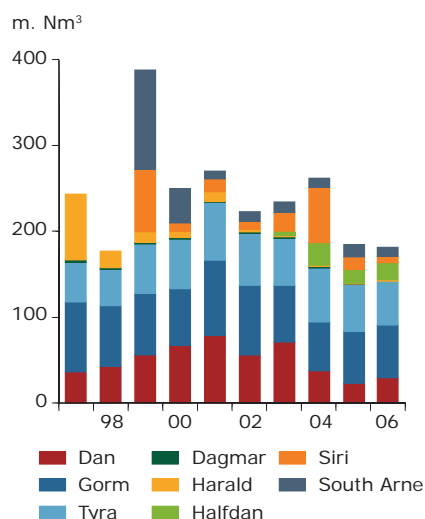
#### Consumption of fuel

Fuel gas and oil account for approximately three-fourths of the total volume of gas and oil used and flared offshore. It appears from Figure 3.1 that the use of gas as fuel has increased gradually on the Danish production facilities during the past decade. This is because oil and gas production increased during the first part of the period. In recent years, the steadily ageing fields have particularly impacted on fuel consumption. For one thing, the volume of water produced increases through a field's life. This augments the need for water injection to maintain pressure in the reservoir, and possibly the injection of lift gas. Both processes are energy-intensive.

The use of fuel gas is expected to continue climbing due to the increased requirements for water injection and gas compression.

As Figure 3.1 shows, fuel consumption varies from year to year at the individual installations. From 2005 to 2006, the use of fuel gas increased at the Dan Field installations, while it decreased at the Tyra Field installations. This decrease occurred because substantially less gas was injected into the field. On the South Arne platform, the use of fuel was almost unchanged relative to 2005, while it increased by almost 20 per cent on the Siri platform due to the expansion of processing facilities.

Fig. 3.2 Gas flaring



#### Gas flaring

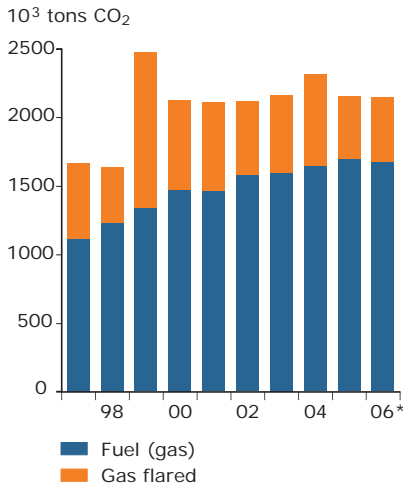
The volumes of gas flared appear from Figure 3.2, and, as the figure shows, gas flaring varies considerably from year to year. These large fluctuations are partially due to the tie-in of new fields and the commissioning of new facilities. In 2006, gas flaring totalled 181 million Nm<sup>3</sup>, a slight decrease compared to 2005 and the lowest volume since 1998.

The decline in gas flaring is chiefly attributable to a 50 per cent reduction of gas flaring at the Siri Field from 2005 to 2006. The volume of gas flared at the Siri Field was at a record low in 2006. Gas flaring also decreased at the Tyra Field installations. However, gas flaring at the Dan Field installations climbed from 2005 to 2006, mainly due to the commissioning of new installations.

#### CO<sub>2</sub> emissions

The development in the emission of CO<sub>2</sub> from the North Sea production facilities since 1997 appears from Figure 3.3. This figure shows that CO<sub>2</sub> emissions totalled

**Fig. 3.3** CO<sub>2</sub> emissions from production facilities in the North Sea



\* In 2006, the calculation was based on verified CO<sub>2</sub> emission data from reports filed under the Danish Act on CO<sub>2</sub> Allowances and included CO<sub>2</sub> emissions from diesel combustion.

about 2.2 million tons in 2006. The production facilities in the North Sea account for about 4 per cent of total CO<sub>2</sub> emissions in Denmark.

Figure 3.4 shows the past ten years' development in CO<sub>2</sub> emissions associated with the consumption of gas as fuel, relative to the volume of hydrocarbons produced.

It appears from this figure that CO<sub>2</sub> emissions due to combustion of fuel have increased relative to the size of production, from about 55,000 tons of CO<sub>2</sub> per million t.o.e. to about 65,000 tons of CO<sub>2</sub> per million t.o.e. over the past decade.

Among other things, the increase is due to the rising average age of the Danish fields. Due to natural conditions, energy consumption per produced t.o.e. increases for every year of a field's production.

It appears from Figure 3.5 that CO<sub>2</sub> emissions from gas flaring relative to the size of production have shown a declining trend since the early 1990s. This trend has been broken in several cases, including in 1997, 1999 and 2004 when the startup of new fields and commissioning of new processing facilities involved the flaring of extraordinary volumes of gas. Gas flaring decreased significantly from 2004 to 2005 and remained stable in 2006.

Appendix A includes a table of the volumes of gas used annually as fuel at the individual production centres, the volumes of gas flared annually and calculated CO<sub>2</sub> emissions.

### The European CO<sub>2</sub> allowance scheme

As of 1 January 2006, the CO<sub>2</sub> allowance scheme covered about 380 installations in Denmark, including seven in the offshore sector.

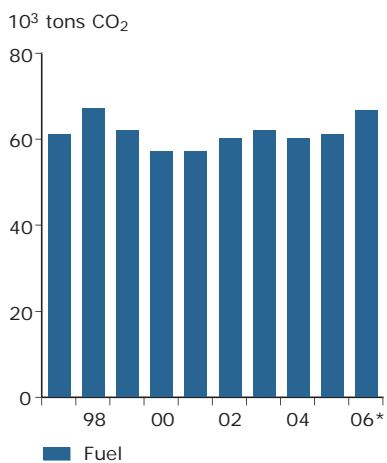
From 2005, installations were required to monitor and measure CO<sub>2</sub> emissions from the individual installation. Approval of a plan for monitoring and measurement of CO<sub>2</sub> emissions on the installation is granted at the same time as the emission permit. On 31 March 2006, each installation reported its CO<sub>2</sub> emissions for 2005 to the DEA and the Allowance Register, and at the end of April 2006, the individual installations surrendered allowances corresponding to their CO<sub>2</sub> emissions in 2005.

Each installation was informed in 2004 about how many free allowances it could expect to receive. If the installation does not use all the allowances allocated, for example due to energy savings, it can sell the allowances on the European allowance market.

The main rule is that the free allowances are granted either on the basis of average emissions during the period from 1998 to 2002, or in an amount equal to the emission in 2002, if this figure is higher. In 2002, the offshore sector emitted 2.1 million tons of CO<sub>2</sub>, and free allowances averaging 2.2 million tons of CO<sub>2</sub> per year were allocated to the Danish offshore sector for the period 2005-2007.

If new installations are established, further allowances can be allocated. The Danish Act on CO<sub>2</sub> Allowances has laid down the criteria for allocating free allowances for the first period from 2005 to 2007. In March 2007, the Minister for the Environment submitted an allocation plan for the subsequent period, 2008-2012, to the European Commission for approval. The allocation plan describes the amount of allowances and the criteria for allocating free allowances. The plan is based on the same principles as for the period 2005-2007, viz. historical emissions.

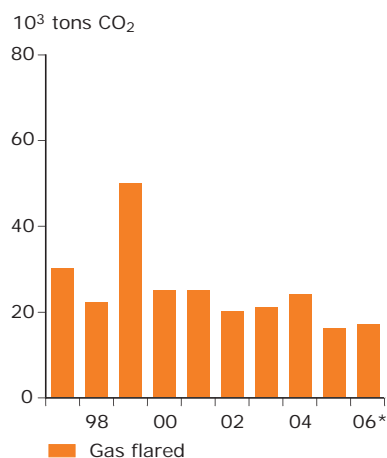
**Fig. 3.4** CO<sub>2</sub> emissions from consumption of fuel per m. t.o.e.



\* In 2006, the calculation was based on verified CO<sub>2</sub> emission data from reports filed under the Danish Act on CO<sub>2</sub> Allowances and included CO<sub>2</sub> emissions from diesel combustion.



**Fig. 3.5** CO<sub>2</sub> emissions from gas flaring per m. t.o.e.



\* In 2006, the calculation was based on verified CO<sub>2</sub> emission data from reports filed under the Danish Act on CO<sub>2</sub> Allowances and included CO<sub>2</sub> emissions from diesel combustion.

Further information about the CO<sub>2</sub> allowance scheme is available at the DEA's website, [www.ens.dk](http://www.ens.dk).

### MARINE DISCHARGES

Marine discharges from oil and gas production activities are subject to approval by the Danish Environmental Protection Agency. After the Offshore Safety Act has entered into force, equipment to reduce marine discharges is regulated by the Marine Environment Protection Act, which comes under the supervision of the Danish Environmental Protection Agency.

### NEW EIA FOR THE SOUTH ARNE FIELD

Major projects in Danish territorial waters and the Danish continental shelf area may have a considerable impact on the environment. Therefore, permits are only granted for projects after an Environmental Impact Assessment, EIA, has been made. In addition, the general public, public authorities and organizations must have an opportunity to submit their opinions.

Hess Denmark ApS is planning to develop the South Arne Field further. Therefore, the company has submitted an EIA to the DEA, describing the total possible environmental impact of the field development projected. The report "EIA for South Arne – field development and production" was issued in October 2006, and a separate non-technical summary of the report has been prepared; see the DEA's website.

The report was subjected to a public hearing during the period from October to December 2006, and Hess Denmark ApS has subsequently provided replies to the public hearing opinions submitted. As the parties to the public hearing have taken note of the replies, the EIA basis for the planned development of the South Arne Field is in place.

### GAS PIPELINE PROJECT BETWEEN RUSSIA AND GERMANY

Two 1,200 km gas pipelines from Russia to Germany are being projected. The pipelines will traverse Finnish, Swedish and Danish offshore areas. In Danish territory, 149 km of the pipelines is to be routed south or north of the island of Bornholm. The company Nord Stream AG has submitted a project description to the Danish authorities. One of the pipelines is to transport natural gas from Russian gas fields to Europe from 2010, while the other gas pipeline is expected to be commissioned in 2013.

The company's project description is preparatory to an upcoming EIA of the project. The description was prepared in accordance with the Espoo Convention, an international convention on environmental impact across borders. For one thing, the Convention stipulates that projects of potential relevance for Convention purposes must be subjected to an international hearing, including a public hearing.

Therefore, the project description was given a public hearing around the turn of the year 2006/2007. The opinions submitted will be incorporated into the planned Environmental Impact Assessment of the project.

The project description can be found at the DEA's website, [www.ens.dk](http://www.ens.dk), and further information about the project is available at Nord Stream AG's website, [www.nord-stream.com](http://www.nord-stream.com).

## **PROTECTION OF THE MARINE ENVIRONMENT**

In May 2007, the Danish Parliament passed various statutory amendments, including to the Danish Subsoil Act and the Danish Continental Shelf Act, to implement the EU Habitats Directive and Birds Directive in respect of offshore installations.

When permission for offshore activities is granted, the environmental impact must be assessed. In some cases, the above-mentioned amendments require that the environmental impact of the activities be subjected to an extended assessment. Such an assessment is necessary to prevent marine areas from deteriorating and animals and birds from being disturbed in international nature protection areas, the so-called Natura 2000 areas.

The existing offshore activities do not take place in any of the international protection areas designated to date. By 2008, the decision is to be made whether further marine areas require protection under the Natura 2000 umbrella. The Minister for the Environment is authorized to designate Natura 2000 areas under the Danish Environmental Targets Act.

## **OFFSHORE ENVIRONMENTAL ACTION PLAN**

In December 2005, the Minister for the Environment introduced an offshore action plan. The aim of the action plan is to help ensure that environmental impacts from oil and gas exploration and production in the Danish part of the North Sea are kept within the limits indicated by national and international regulations. The action plan deals with the following subjects: the use of chemicals, marine oil discharges, emissions to the atmosphere, environmental management and environmental reports as well as supervision and emergency procedures. The action plan is to be evaluated in the course of spring 2007.

One of the requirements laid down by the action plan is that operators are to prepare an annual environmental report. The report is to give an account of all environmental impacts and to be made public; see the Danish Environmental Protection Agency's website, [www.mst.dk](http://www.mst.dk).

## **INTERNATIONAL COOPERATION UNDER THE OSPAR CONVENTION**

The international cooperation under the OSPAR Convention continues to focus on a harmonized effort to reduce discharges into the sea. For the offshore oil and gas industry, the goal is a 15 per cent reduction in the total volume of oil discharged with produced water over the period from 2000 to 2006.

Moreover, under the auspices of OSPAR, work is proceeding on projects to implement environmental management systems on offshore installations and to deposit CO<sub>2</sub> in the subsoil below the seabed.

At present, a study is being conducted to clarify the relationship between the OSPAR Convention and the future EU marine strategy. At the same time, investigations are underway to determine how the new EU rules on chemicals, REACH, will affect OSPAR's chemicals regulation system, HMCS.

## 4. HEALTH AND SAFETY



The drilling rig Maersk Enhancer

The production installations on the Danish continental shelf in the North Sea, as well as drilling rigs and miscellaneous vessels associated with oil and gas production, provide jobs for up to 3,000 people. The employees have a multitude of different skills and include blacksmiths, electricians, geologists, engineers, painters, scaffolders, catering staff, nurses, etc.

High health and safety standards in the Danish offshore sector are vital to the people having their workplace on the offshore installations.

Moreover, health and safety conditions on the installations have a major impact on the operating economy of the companies carrying on exploration and production activities.

On behalf of the Danish state, the DEA supervises whether companies comply with existing health and safety legislation when conducting their oil and gas activities.

### SUPERVISION IN 2006

The DEA supervises the health and safety conditions of exploration and production activities, both offshore and onshore.

#### Box 4.1

##### Safety-critical equipment

Safety-critical equipment is equipment where a single failure would involve a serious risk of an accident. It includes equipment used in systems for fire and gas detection, for the shutdown and depressurization of processing plants and for fire-fighting and evacuation, as well as general safety equipment.

On its inspection visits to offshore installations in 2006, the DEA checked whether the operators adhere to their plans for maintaining installations and equipment, and whether they pay special attention to the maintenance of safety-critical equipment.

Inspection visits in 2006 showed that the majority of all offshore installations maintain their safety-critical equipment as planned.

Supervision will continue to focus on safety-critical equipment in 2007.

In 2006, the DEA carried out 31 offshore inspections, which focused on matters such as the working environment and general condition of the installations. During these inspection visits, the DEA also performed subject-specific audits and followed up on focus areas. Inspection visits to offshore installations are made at regular intervals, and when otherwise required.

During inspection visits, the DEA also addresses any problems ascertained in connection with an inspection or audit. In addition, the DEA meets with the safety organization and safety representatives on the offshore installation.

Inspection visits are also paid to drilling rigs arriving in Denmark from abroad before they begin operating in Denmark.

In 2006, the DEA also made a number of onshore inspection visits and audits related to offshore activities.

An outline of all inspection visits in 2006 is available at the DEA's website, which also includes information about the fixed offshore installations in the Danish part of the North Sea and a list of mobile offshore units operating in Danish waters in 2006.

As in previous years, supervision in 2006 focused on work-related accidents, "near-miss" occurrences, gas leakages and the maintenance of safety-critical equipment; see Box 4.1.

The DEA's supervisory efforts also include continuous follow-up on work-related accidents and "near-miss" occurrences offshore.

The Danish Government's working environment programme for the period until 2010 pivots on work-related accidents, the psychological working environment, noise, as well as musculoskeletal disorders. The DEA's supervision activity will include these programme areas until 2010.

#### Box 4.2

##### **Workplace Assessment (WPA)**

A Workplace Assessment (WPA) must substantiate that the operating company has assessed the health and safety risks on the offshore installation. The operating company is defined as the operator and other companies in charge of operations, for example drilling contractors.

As a minimum, a WPA must contain:

- A detailed description of the offshore installation and its operating conditions.
- A detailed description of the health and safety management system, which is to ensure and substantiate compliance with legislation in both normal and critical situations.
- An identification of the risks of major accidents and work-related injuries and diseases.
- An assessment of the risks and documentation showing that such risks are “as low as reasonably practicable” (ALARP).
- Documentation showing that employees can be evacuated in an efficient and controlled manner in critical situations.

The WPA must be updated whenever the health and safety conditions on the installation undergo a major modification.

#### Box 4.3

##### **Reporting work-related accidents**

Work-related accidents resulting in incapacity to work for one or more days beyond the injury date must be reported. Accidents may be reported by means of a reporting form or through the electronic reporting system, EASY. Both forms are available at the DEA’s website.

Employers are obligated to report accidents, but all other parties are entitled to file reports.

#### Box 4.4

##### **Reporting “near-miss” occurrences**

“Near-miss” occurrences are defined as occurrences that could have directly led to an accident involving personal injury or damage to the offshore installation. The occurrences to be reported to the DEA are outlined in the Guidelines on Reporting Accidents, available at the DEA’s website.

#### **NEW OFFSHORE SAFETY ACT**

A new Act on Health and Safety on Offshore Installations entered into force on 1 July 2006. The Act, subsequently amended in February 2007, replaces the former Offshore Installations Act, dating 25 years back. A number of Executive Orders entered into force concurrently with the Act. The DEA’s website contains more information about the Offshore Safety Act; see [www.ens.dk](http://www.ens.dk).

The Act regulates offshore health and safety issues, including the safety and stability of offshore installations and the employees’ health, safety and working environment.

The Act covers design, construction, installation, operation, maintenance, major modifications and the decommissioning of fixed offshore installations. Moreover, the Act regulates mobile offshore units, such as drilling rigs.

The Act is based on the principle that the companies in charge of operations are also responsible for health and safety on board the installations. The companies are thus obliged to limit health and safety risks to the extent practically feasible.

The Act has introduced a requirement to the effect that a so-called Workplace Assessment (WPA) must be available on each individual offshore installation; see Box 4.2. The WPA must include a risk assessment and document the health and safety management system on the offshore installation. Applications for approval of the design of fixed offshore installations or for operating permits and major modifications must include a WPA.

#### **WORK-RELATED INJURIES**

Work-related injury is a generic term for work-related accidents and work-related diseases. Work-related accidents on offshore installations must be reported to the

**Table 4.1** Reported accidents broken down by category for 2006

Categories	Fixed	Mobile
Falling/tripping	13	3
Use of work equipment	9	1
Handling goods	0	1
Crane/lifting operations	1	1
<b>Total</b>	<b>23</b>	<b>6</b>

DEA; see Box 4.3. Major “near-miss” occurrences must also be reported to the DEA; see Box 4.4.

### Preventing work-related accidents

To prevent work-related accidents, we need to understand the root causes of such accidents. One aim of the DEA’s follow-up on work-related accidents is to keep up the safety organization’s efforts to take preventive measures on offshore installations.

The DEA registers and processes all reported work-related accidents on Danish offshore installations and evaluates the follow-up procedures taken by the companies. At the DEA’s inspection visit, all work-related accidents since the last visit are addressed at meetings with the safety organization on the installation.

In 2006, the DEA registered a total of 29 reports concerning work-related accidents, 23 on fixed offshore installations, including accommodation units, and six on mobile offshore units. The accidents are broken down by category, as shown in Table 4.1 and Figure 4.1.

### Accidents during the use of high-pressure equipment

In 2006, the DEA received reports about three work-related accidents and one “near-miss” occurrence during work with high-pressure equipment.

In May 2006, a work-related accident occurred during a sandblasting operation at Tyra West. A coupling of the high-pressure hose snapped, and the equipment blasted sand/air under high pressure into the face of an employee. The employee concerned was evacuated by helicopter to Esbjerg Hospital. During a subsequent inspection visit, the DEA investigated how the operator had followed up on the accident.

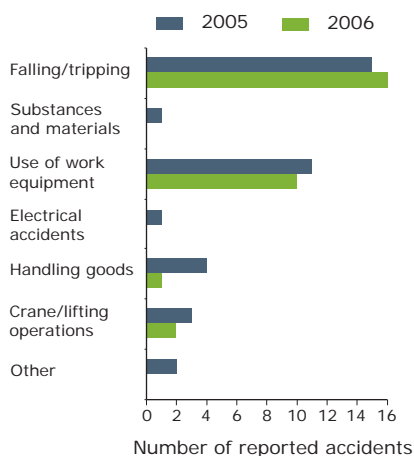
Within the space of a few days in October 2006, two work-related accidents and one “near-miss” occurrence took place on Dan F during an epoxy spray-paint operation. Epoxy paint is used for surface treatment on offshore installations. It adheres extremely well to the materials painted, but also represents a health hazard to those coming into contact with the product.

In the case of both work-related accidents, a leak occurred when the equipment was assembled, and employees were sprayed with epoxy paint on their legs and eyes, respectively. Shortly afterwards, on the same installation, there was a “near-miss” occurrence, again in the form of a leak resulting from assembly of the equipment.

Due to these occurrences, Mærsk Olie og Gas AS, the operator for both installations, dealt with the reported work-related accidents and the “near-miss” occurrence at extraordinary safety organization meetings and changed its procedures for such high-pressure operations.

During subsequent inspection visits, the DEA focused particular attention on procedures for work with high-pressure equipment, including the planning and safety assessment of the work. In addition, the DEA has audited the distribution of responsibility between the contractor and operator in respect of offshore work.

**Fig. 4.1** Comparison between accidents reported in 2005 and 2006 for offshore installations broken down by category



**Table 4.2** Actual absence due to reported work-related accidents

Duration	Fixed	Mobile
1-3 days	0	0
4-14 days	2	0
2-5 weeks	8	2
More than 5 weeks	8	3
Undisclosed	1	0
Still on sick leave	4	1
<b>Total</b>	<b>23</b>	<b>6</b>

#### **Accident during crane-lifting operation**

On 23 December 2006, an employee was seriously injured on the deck of the Gorm C platform during a crane-lifting operation. The employee in question suffered serious head injuries and was evacuated to shore for treatment.

The DEA paid a visit to the Gorm installation, together with the police, immediately after the accident. The exact cause of the accident could not be established on the basis of investigations and interviews on the installation, but the employee presumably got caught between two containers.

At the DEA's request, the operator, Mærsk Olie og Gas AS, has revised its lifting operation procedures for the purpose of minimizing the risk of repetitions.

Table 4.2 indicates the actual periods of absence from work attributable to the accidents reported, broken down on fixed and mobile offshore units. In previous years, the expected period of absence, not the actual absence, was reported. This change in statistical method provides a truer picture of the seriousness of the accidents.

#### **Collision with the Tyra West E platform**

On the night of 6 July 2006, a Danish registered trawler with a Dutch crew collided with one of the legs of a platform at Tyra West.

The collision only resulted in minor damage to a working deck supported by the platform leg and to the stern of the trawler. It was soon evident that the damage to the installation did not impact on its safety. The trawler could proceed under its own steam.

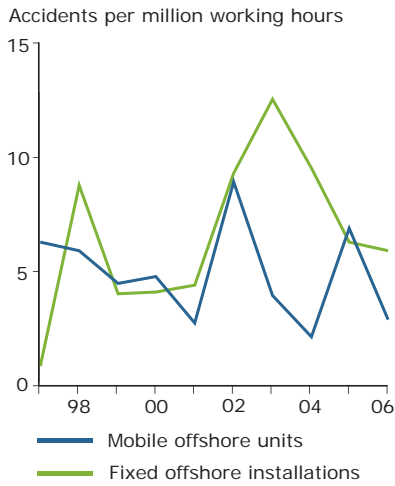
The DEA paid an inspection visit to Tyra West the day after the collision and ascertained that the trawler had not been observed until it was navigating between the platforms at Tyra West.

Mærsk Olie og Gas AS is the operator of the Tyra Field. The DEA ordered the operator to step up the surveillance of all its North Sea installations immediately. At the same time, the DEA demanded that a standby vessel be present at Tyra West until the cause of the trawler's collision with the platform had been fully clarified. In addition, the DEA demanded that the operator, on the day the collision occurred, instigate an independent survey regarding the scope of the platform damage.

The Danish Maritime Authority's Division for Investigation of Maritime Accidents has investigated the cause of the collision and prepared a report available at the Danish Maritime Authority's website, [www.dma.dk](http://www.dma.dk).

The DEA has reported the trawler to the police for crossing the 500-metre safety zone around the installation.

**Fig. 4.2** Accident frequency on offshore installations



### Accident frequency

Every year, the DEA calculates the overall accident frequency, which is defined as the number of accidents reported per million working hours.

The accident frequencies for fixed offshore installations and mobile offshore units in recent years appear from Figure 4.2. The overall accident frequency for mobile units and fixed offshore installations came to 4.9 accidents per million working hours in 2006. This is a reduction compared to 2005, when the accident frequency was 6.4 accidents per million working hours.

For mobile offshore units – which included pipe-laying barges and crane barges until the Offshore Safety Act entered into force on 1 July 2006 – six work-related accidents were recorded in 2006, and the number of working hours totalled 2.10 million. Accordingly, the accident frequency for mobile offshore units was calculated at 2.9 accidents per million working hours in 2006.

The number of work-related accidents on fixed offshore installations and accommodation units totalled 23 in 2006. The operators have stated that the number of working hours totalled 3.87 million on these offshore installations. The accident frequency for fixed offshore installations was calculated at 5.9 accidents per million working hours in 2006.

### Work-related diseases

Work-related diseases are reported by doctors to the National Working Environment Authority and the National Board of Industrial Injuries; see Box 4.5.

In 2006, ten work-related diseases were reported, on the basis of a doctor’s assessment that the relevant work-related disease was primarily contracted due to work on offshore installations. The diseases reported are distributed on six hearing injuries, three musculoskeletal disorders and one case of eczema.

**Box 4.5**

#### Work-related diseases

A work-related disease is defined as an illness or a disease arising as a result of long-term exposure to work-related factors or the conditions under which the work is performed. A doctor is usually the first to suspect that a disease is work-related. Doctors are obliged to report such diseases to the public authorities.

#### Fatal work-related disease

In 2004, the National Board of Industrial Injuries recognized a reported cancer case as work-related. The disease led to the person’s death in 2006.

The deceased’s work included repairing and maintaining pumps and gas turbines on platforms, and he was therefore frequently in contact with chemicals such as hydraulic and turbine oils. These chemicals are carcinogenic.

The DEA supervises the procedures for working with chemicals, including the duty to issue instructions and monitor the activities, as well as bathing and changing facilities.

In this connection, the DEA has focused on ensuring that the possibility of substituting chemicals, processes and equipment is regularly assessed to a satisfactory degree.

As a new initiative, the operator has also developed a course on chemical safety. The aim of the course is to improve the procedures for working with chemicals. In this connection, the DEA is following up on the initiative during inspection visits offshore.

### **Asbestos on offshore installations**

After being out of the public spotlight for a number of years, asbestos has become a hot topic in Denmark again.

The DEA supervises the risks associated with the possible existence of asbestos and materials containing asbestos on offshore installations in Denmark. To clarify whether this area requires increased focus, the DEA launched an initiative in 2007 to update existing data on the scope of asbestos and materials containing asbestos on Danish offshore installations.

Based on information received from the operators, the DEA's preliminary conclusion is that the presence of asbestos cannot be established in the indoor environment on the platforms and that the materials used on the platforms are unlikely to contain asbestos.

The DEA has informed the operators that they should pay greater attention to asbestos. At the same time, they were urged to carry out systematic investigations to locate any asbestos on the older offshore installations.

### **"Near-miss" occurrences**

In 2006, the DEA received a total of ten reports on "near-miss" occurrences.

In one incident, an oil pump motor weighing 60 kg dropped 27 metres onto the deck of a drilling platform during handling of a drillpipe.

The incident was triggered by a collision between the motor that powers the drillpipe during drilling work (top-drive) and the top of a drillpipe. In the process, the oil pump motor became loose and fell down. No-one was injured. Investigations into the causes of the incident showed, among other things, that those working in the derrick and those on the drilling floor needed to improve coordination efforts when moving drillpipes.

Another incident occurred during routine pressurization testing on a drilling rig. Here the top of the production string suddenly shot up through the derrick, causing damage to equipment. A firm of specialists did not deem the damage to be critical, and spare parts were ordered to replace the damaged ones and continued the operation.

A few months later, a "near-miss occurrence" occurred on the same drilling rig, in which a 10 kg section of pipe dropped approx. 20 metres onto the drilling floor. Investigations showed that the pipe came from the top-drive, which had been damaged during the previous incident. Because of the delivery time for the spare part, the damaged part had not yet been replaced.

Closer investigation showed that the damage following the first incident had been underestimated. In addition to damage from that incident, there was also found damage originating from manufacturing defects and corrosion.

The DEA got in touch with the companies concerned immediately after the incidents and as part of the subsequent analysis work to clear up the circumstances surrounding the incidents. The DEA's inspection visit to the rigs will include additional follow-up.

### **Amended Danish regulations for safety training**

In Denmark, the regulations on safety training courses were amended with effect from 1 May 2007. The amendments are intended to improve the standard of safety training and to ensure that Danish offshore safety training courses are recognized in the other North Sea countries.

The basic safety training course that is compulsory for all offshore employees differs substantially from previous safety training. For one thing, the training course now includes first aid and personal safety. Guidelines about the new regulations on offshore safety training are available at the DEA's website, [www.ens.dk](http://www.ens.dk).



**Box 4.6** Categories of hydrocarbon releases

**Class I:**  
> 10 kg/sec. or more than 100 kg in total

**Class II:**  
1-10 kg/sec. or more than 10 kg in total

**Class III:**  
0.1-1 kg/sec. or more than 1 kg in total

**Gas leakage in the Siri field**

On 1 December 2006, a gas leakage occurred on the Siri platform, for which DONG E&P A/S is the operator. The release triggered automatic shutdown of the installation, resulting in the loss of all power supply and communications systems. The emergency power supply (UPS) and the communications systems were operational again after about 1½ hours. As a precaution, helicopters were on standby to evacuate the crew on Siri, if necessary.

The DEA paid a visit to the Siri platform on the following day to investigate the incident, at which time the operator also had an investigation team on site.

On 5 December 2006, the DEA received an investigation report about the incident from the operator, and the DEA subsequently informed the company that it supported the recommendations made in the report.

**GAS LEAKAGES**

Gas leakages constitute an area comprised by the DEA’s routine supervision. The operators are obliged to register all hydrocarbon releases and to report class I and II releases to the DEA; see Box 4.6.

In 2006, three class II releases were reported. In addition, the operators have stated that there were nine class III releases. Thus, in 2006, the number of class I and class II releases declined, while the number of class III releases remained at the same level as in 2005; see Figure 4.3.

During offshore inspection visits, the causes of the reported gas leakages and the follow-up taken by the operators to prevent similar occurrences in future are discussed.

**INTERNATIONAL COOPERATION THROUGH NSOAF**

The DEA cooperates with the other North Sea countries through the North Sea Offshore Authorities Forum (NSOAF). The objective of this cooperation is to ensure that health and safety conditions connected with oil and gas activities in the North Sea are continuously improved. The DEA participates in three working groups under the auspices of NSOAF:

**Wells Working Group (WWG)**

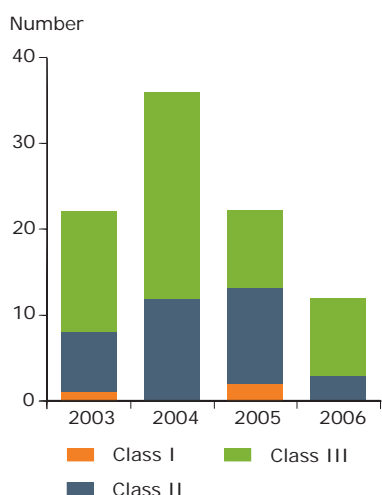
In the Wells Working Group, the parties cooperate on health and safety in connection with drilling operations and drilling equipment. The group was set up in continuation of the previous informal cooperation between the North Sea countries in this area.

**Training Working Group (TWG)**

For a number of years, this group has made efforts to ensure that offshore safety training completed in one country is also recognized in the other North Sea countries.

In 2006, the parties to NSOAF agreed on a proposal for a common standard for basic offshore safety training prepared by the International Association of Drilling Contractors (IADC). The standard is to apply worldwide to the members of the organization, viz. owners of drilling rigs.

**Fig. 4.3** Accidental hydrocarbon releases



As yet, no corresponding standards apply to employees on fixed offshore installations, but the Training Working Group has urged the operators of fixed offshore installations to draw up a standard.

### **The Health Safety & Environment Working Group (HSE WG)**

The Health Safety & Environment Working Group has designated five focus areas: supervision, an ageing workforce, lifting operations and equipment, the safety status of fixed offshore installations and mobile offshore units, as well as indicators of health, safety and environment. The main purpose of the participants' work is to exchange experience within the above-mentioned focus areas.

### **Safe lifting operations**

To evaluate the safety of lifting operations, lifting audits were conducted on a number of offshore installations in 2006/2007. In Denmark, the DEA chose to carry out audits on the drilling rig Noble Byron Welliver (Noble Drilling), the Dan F complex (Mærsk Olie og Gas AS) and the Siri Platform (DONG E&P A/S).

The results of the audit will be presented in a common report, expected to contain recommendations for the work carried out by the Offshore Mechanical Handling Equipment Committee (OMHEC) in connection with safety issues related to cranes and lifting equipment used offshore.

OMHEC is an organization for cooperation between representatives of offshore authorities in the UK, Norway, the Netherlands and Denmark, as well as verification bodies and specialists in the area. In 2006, a formalized cooperation agreement was concluded between NSOAF and OMHEC, according to which NSOAF will consult OMHEC on health and safety issues related to offshore crane and lifting operations.

### **SAFETY STANDARDS ON DANISH OFFSHORE INSTALLATIONS**

The objective of the Offshore Safety Act is to keep the safety standards on Danish offshore installations among the highest in the North Sea countries. Accident frequency is one of the indicators used to assess safety.

The DEA has compared the accident frequency on Danish offshore installations with data from comparable industries in Denmark and from the offshore industry in other countries.

### **Accident frequency in other Danish industries**

The rules regarding the reporting of work-related accidents for Danish offshore installations are the same as those applicable to onshore industries in Denmark. This allows a comparison between the individual industries in Denmark.

Accidents occurring onshore must be reported to the National Working Environment Authority, and to the DEA if occurring on an offshore installation.

The National Working Environment Authority calculates the accident frequency for onshore industries in Denmark on the basis of the number of accidents reported proportionate to the entire workforce, i.e. the number of employees. The National Working Environment Authority uses workforce statistics indicating the number of persons who had their main job in the relevant industry in November in the year in question. However, the DEA uses the number of actual working hours reported annually by the operators.

**Table 4.3** Accident frequencies in Danish offshore and onshore industries

Industry	Frequency		
	2004	2005	2006
Offshore installations*	7.1	6.4	4.9
Total onshore industries	10.5	10.4	
Of which:			
- Shipyards	36	52.9	
- Earthwork, building and road construction	21.1	22.4	
- Masonry, joinery and carpentry	15.5	17.3	
- Insulation and installation work	16.1	17.9	
- Chemical industry	12.3	12.7	
- Heavy raw materials and semi-manufactures**	13.3	11.8	

Note: The figures for onshore industries for 2004 have been calculated on the basis of updated figures from the National Working Environment Authority's annual statistics for 2005 ([www.at.dk](http://www.at.dk)).

\*) Overall accident frequency for fixed offshore installations and mobile offshore units as well as accommodation units.

\*\*) Heavy raw materials and semi-manufactures" covers many industries. For example, some of the subgroups within "Heavy raw materials and semi-manufactures" include the extraction of crude oil and natural gas and technical services related to oil and gas extraction activities.

Table 4.3 shows the accident frequencies calculated by the DEA for 2004-2006 and the accident frequencies published by the National Working Environment Authority for 2004 and 2005.

The figures for onshore companies are calculated on the assumptions that the total number of working days is 222 days per year and that each working day averages 7.12 working hours. On this basis, the accident frequency has been calculated at 10.4 for all 50 onshore industries in 2005.

The DEA has calculated the accident frequencies for the Danish onshore industries whose jobs most resemble those in the offshore sector. The accident frequencies for the offshore sector and for a number of comparable onshore industries appear from Table 4.3.

#### Accident statistics for the offshore sector in other countries

Other countries also publish statistics about accidents on offshore oil and gas installations. These statistics are based on legislation and a registration system that differs from that used in Denmark. This makes a direct comparison misleading.

#### EU accident statistics

The general accident statistics prepared by the EU organization, EUROSTAT, are not so detailed as to allow direct comparisons between the member countries' offshore industries.

However, the EU member countries have previously cooperated on statistics, which included collecting and presenting accident statistics for the offshore oil and gas industry in the countries around the North Sea.

This cooperation took place under the auspices of the now abolished EU Safety and Health Commission for Mining and Other Extractive Industries, resulting in the publication of the report "Report on Accidents Statistics 1991 - 2000 for the European Borehole Related Extractive Industry".

The countries providing statistics for the report had made their data comparable to the largest extent possible. Nevertheless, the report states that the data is based on the individual countries' existing reporting requirements, which, as the report points out, diverge somewhat. This makes it problematic, or in some cases directly misleading, to make direct comparisons between the individual countries' accident statistics.

Moreover, it appears from the report that due to the major discrepancies between how the participating countries classify the seriousness of accidents, it was considered impossible to make transnational comparisons of accident severity in the report.

#### OGP accident statistics

The International Association of Oil and Gas Producers (OGP) publishes information about safety conditions in the oil industry every year. The information published is based on accident statistics supplied by OGP members.

For Denmark, OGP reported an accident frequency (accidents involving loss of working hours) of 4.0 per million working hours for 2005. The corresponding figures for Norway and the UK are 1.5 and 1.2, respectively. Overall, the accident frequency for Denmark for 2005 is one of the highest in the reports.

The DEA calculated the accident frequency for the Danish offshore industry in 2005 at 6.4 accidents per million working hours, which is somewhat higher than the figure published by OGP. Hence, the OGP accident-frequency statistics are scarcely directly comparable with the consolidated Danish figures.

#### **Accident frequencies for Denmark, Norway and the UK**

To form a picture of the development in offshore accident frequencies in Denmark, Norway and the UK, the DEA based its figures on the accident statistics from the EU for the years 1991 to 2000.

For the years after 2000, using the most recent figures from the EU, the DEA has scaled the official national statistics for 2000, to bring them into line with the EU statistics. The resulting adjustment factor for each country for the year 2000 was subsequently used to restate the official figures from the countries for the period 2001 to 2005. The results of this restatement appear from Figure 4.4. The figure indicates that Norway and the UK recorded a downward trend in accident frequencies after 2000, while accident frequencies in Denmark after 2001 were generally higher than in the preceding years, although tending to decrease over time. This declining trend continued in 2006; see Figure 4.2.

Even though accident frequency in the Danish offshore industry is low compared to onshore industries, the comparison with the same industries in other countries indicates there is room for improvement; see Figures 4.2 and 4.4. Therefore, the DEA will take up this subject with the operators.

#### **Registration of offshore accidents in other oil-producing countries**

The countries around the North Sea use different criteria for registering accidents connected with offshore oil and gas activities. Consequently, the databases for the accident statistics vary, thus preventing a direct comparison.

Moreover, the workplaces covered by the offshore accident statistics differ in the individual countries, as does the way the number of hours worked offshore is calculated.

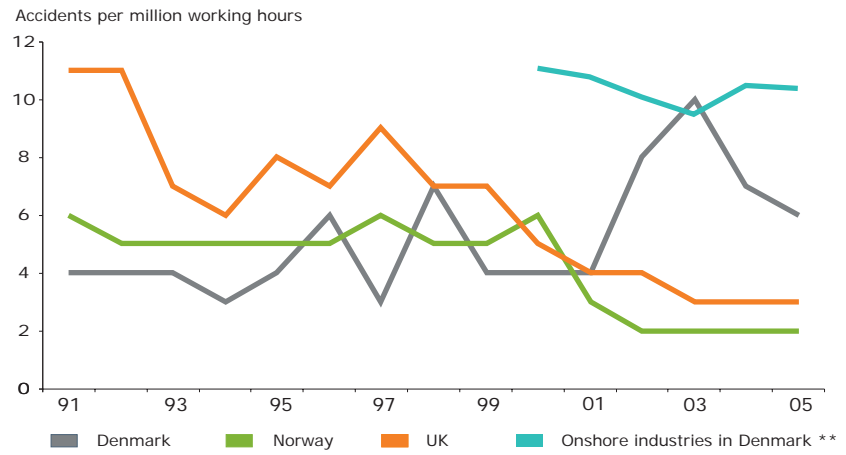
**Denmark:** Accidents are registered when they result in incapacity to work for more than 24 hours beyond the injury date. The duration of absence from work is used to classify accident severity. This applies both on- and offshore.

**Norway:** Accidents are registered when they result in absence from work during the next 12-hour shift, or if the accident leads to a change of jobs. Accidents requiring medical treatment are also registered. Accident severity is classified according to type of accident.

**UK:** Accidents are registered when they result in full incapacity to work for more than three days beyond the injury date. Accident severity is classified according to type of accident.

**EU:** EU statistics on work-related accidents are compiled on the basis of incapacity to work for more than three days beyond the injury date.

**Fig. 4.4** Normalized offshore accident frequencies\* compared to all onshore industries\*\*



\* The figures from 1991-2000 are from the EU's report. The figures have been scaled unscientifically on the basis of 2000 to bring the national statistics for 2000-2005 into line with the earlier EU statistics. Therefore, the Danish figures are not directly comparable with those in Figure 4.2. The Norwegian figures have been "reduced" to 20 per cent.

\*\* Accidents for 2000-2005 reported to the National Working Environment Authority.

## 5. RESERVES

The DEA makes an assessment of Danish oil and gas reserves annually. At 1 January 2007, oil reserves were estimated at 240 million m<sup>3</sup> and gas reserves at 120 billion Nm<sup>3</sup>.

The DEA's new assessment shows a decline in oil and gas reserves of 7 and 2 per cent, respectively, compared to the assessment made at 1 January 2006. The decrease in reserves is mainly attributable to production in 2006.

The total ultimate recovery of oil expected has been written up by 3 million m<sup>3</sup> compared to last year's assessment. Oil production amounted to 20 million m<sup>3</sup> in 2006, and oil reserves have thus declined by 17 million m<sup>3</sup>.

At 1 January 2007, 297 million m<sup>3</sup> of oil had been produced, with reserves amounting to 240 million m<sup>3</sup>. Accordingly, total production during the period 1972-2006 amounts to 55 per cent of the ultimate recovery expected; see Figure 5.1.

It is expected that technological developments and any new discoveries resulting from exploration activity, including from the 6th Licensing Round, will add new reserves to future assessments.

### Five-year production forecast

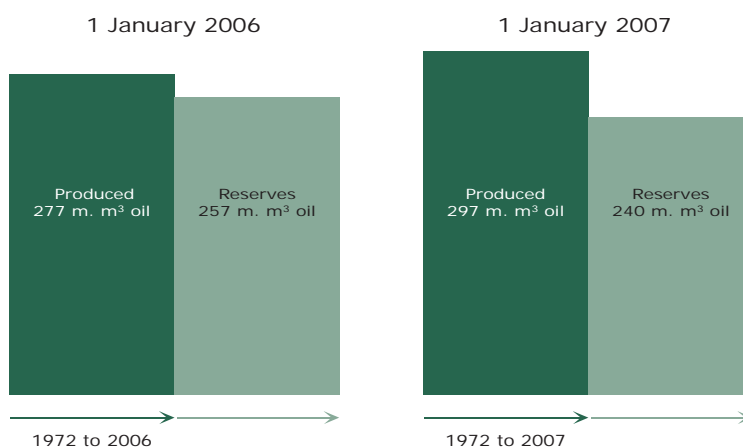
For the purpose of its annual report, the DEA prepares a five-year forecast for the production of oil and natural gas. This forecast is revised every autumn.

#### *Oil*

For 2007, oil production is expected to total 19.0 million m<sup>3</sup>, equal to about 327,000 barrels of oil per day; see Table 5.1. This is a reduction of 4 per cent relative to 2006, when oil production totalled 19.8 million m<sup>3</sup>, and a 9 per cent downward adjustment on last year's forecast for 2007, due mainly to lowered production estimates for the Dan, Gorm and Halfdan Fields.

Oil production is expected to decline in the period from 2008 to 2010. On average, the production estimate for the forecast period has been written down 9 per cent relative to last year's forecast, primarily because of lowered expectations for production from the Dan, Gorm and Halfdan Fields and a postponed production startup of the Hejre discovery.

Fig. 5.1 Oil production and oil reserves



### Natural gas

Natural gas production is estimated at 9.1 billion Nm<sup>3</sup> for 2007; see Table 5.1. The estimates for 2007 and 2008 are unchanged from last year's forecast, but the estimates for the following years have been adjusted, although without impacting on the total natural gas production figure for the forecast period.

Table 5.1 Expected production of oil and natural gas

	2007	2008	2009	2010	2011
Oil, million m <sup>3</sup>	19.0	17.8	16.9	16.1	16.6
Natural gas, billion Nm <sup>3</sup>	9.1	9.1	9.1	8.4	7.8

### Five-year production forecast, degrees of self-sufficiency

Denmark has been net self-sufficient in energy since 1997. Self-sufficiency is measured in terms of energy production and consumption, calculated on the basis of energy statistics. The consumption of various energy products is not distributed in the same way as production, so some products are imported even though, taken overall, Denmark is self-sufficient in energy.

In 2006, the total production of oil, gas and renewable energy exceeded total energy consumption by 45 per cent. This is a decline on the year before, when production exceeded consumption by 56 per cent. Lower oil production primarily caused this decline.

In 2006, oil and gas production was 30 per cent higher than total energy consumption and 108 per cent higher than total oil and gas consumption.

Table 5.2 shows the development in the degrees of self-sufficiency projected by the DEA for the next five years and includes the DEA's most recent forecast of energy consumption and renewable energy production. Scenario A shows Danish oil and gas production relative to total domestic consumption of oil and gas, and scenario B shows Danish oil and gas production relative to total domestic energy consumption. Scenario C shows the expected development in the total production of oil, gas and renewable energy relative to total energy consumption in Denmark.

Table 5.2 Degrees of self-sufficiency

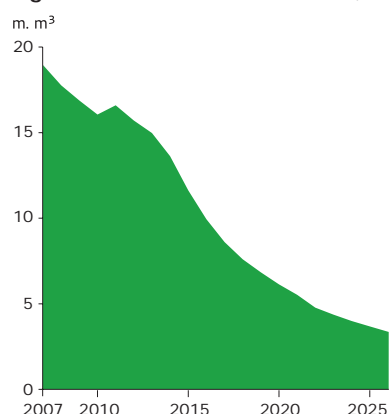
	2007	2008	2009	2010	2011
<b>Production in PJ</b>					
Oil	702	659	626	596	616
Gas	393	394	395	366	343
Renewable energy	144	145	150	155	157
<b>Energy consumption (PJ)</b>					
Total	839	836	834	836	842
<b>Degrees of self-sufficiency (%)</b>					
A	207	200	194	182	178
B	131	126	122	115	114
C	148	143	140	134	132

A. Oil and gas production vs. oil and gas consumption

B. Oil and gas production vs. total energy consumption

C. Production of oil, gas and renewable energy vs. total energy consumption

**Fig. 5.2** Contribution from reserves, oil.



Compared to the corresponding figures published in “Oil and Gas Production in Denmark 2005”, the expected degrees of self-sufficiency in the table show a general decline. This is mainly because oil production estimates have been written down compared to last year’s estimates.

As appears from Table 5.2, the DEA expects Denmark to continue being self-sufficient in energy for the next five years. A long-term assessment of self-sufficiency in oil and gas appears from the section “Twenty-year production forecast”.

### Twenty-year production forecast

Every year, the DEA prepares 20-year forecasts for the production of oil and natural gas based on the reserves assessment, termed the contribution from reserves (oil/gas) below.

A forecast covering 20 years is most reliable in the first part of the period. The methods used in making the forecasts imply that production will decline after a short number of years.

For oil, the contribution from reserves shows a generally declining trend; see Figure 5.2. However, production is expected to increase in 2011 due to the development and further development of various fields.

The forecast does not provide for major field developments after 2011, and ten and 15 years from now, production is expected to constitute about 50 and 25 per cent of production in 2006, respectively.

However, this decline is expected to be curbed as a result of technological developments and any new discoveries made as part of the ongoing exploration activity, including the 6th Licensing Round.

As opposed to the production of oil, which can always be sold at the current market price, the production of natural gas requires that long-term sales contracts have been concluded.

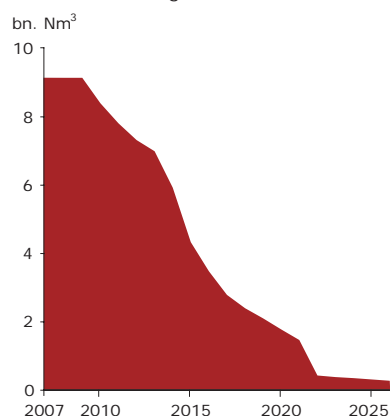
Since the start of gas sales in 1984, natural gas produced under A.P. Møller’s Sole Concession has been supplied primarily under gas sales contracts concluded between the DUC companies and DONG Naturgas A/S. The present gas sales contracts do not stipulate a fixed total volume, but rather an annual volume that will be supplied for as long as DUC considers it technically and financially feasible to carry on production at this level.

In 1997, a contract was concluded between the Hess Denmark ApS group and DONG Naturgas A/S for the sale of gas from the South Arne Field, and, in 1998, a contract was concluded with DONG Naturgas A/S for the sale of the DONG group’s share of gas produced from the Lulita Field.

In addition, the forecast includes the natural gas production resulting from new contracts for the export of gas through the pipeline from Tyra West via the NOGAT pipeline to the Netherlands.

Figure 5.3 shows the contribution from reserves for natural gas. The volume of production is expected to remain fairly constant for the next few years, and subsequently to decline.

**Fig. 5.3** Contribution from reserves, natural gas.





### Twenty-year production forecast, self-sufficiency

The DEA prepares forecasts for the consumption of oil and natural gas in Denmark. Figure 5.4 shows the amount of oil produced and historical consumption. Moreover, the contribution from reserves and the DEA's most recent consumption forecast appear from the figure.

The consumption and production forecasts diverge significantly. The consumption forecast shows a slightly increasing trend, while the production forecast indicates a marked downward trend. Production drops because the forecast does not predict the further development of known fields by means of new technology or the development of new discoveries. On the basis of these production assumptions, Denmark is expected to be self-sufficient in oil up to and including 2016.

The natural gas forecasts show a scenario similar to the oil forecasts. On the basis of the contribution from reserves, Denmark is forecast to be self-sufficient in natural gas up to and including 2015.

However, technological developments and any new discoveries made as part of the ongoing exploration activity are expected to contribute additional production and thus prolong Denmark's period of self-sufficiency in oil and natural gas; see below.

### RESOURCES

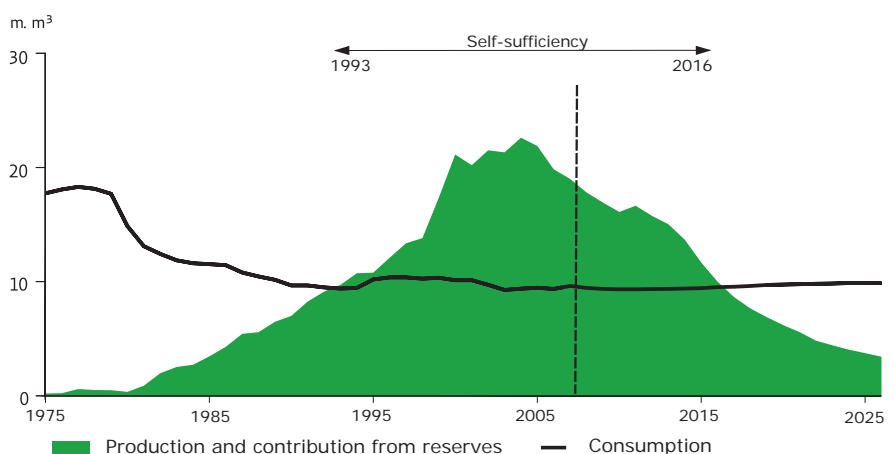
The above-mentioned forecasts have been made on the basis of the DEA's reserves assessments and thus do not include estimated contributions from the further development of known fields by means of new technology or the development of new discoveries. An estimate of Danish oil and gas resources can be subdivided into three components:

**A contribution from reserves**, calculated on the basis of the volumes of oil and gas that can be recovered from known fields and discoveries by means of existing production methods.

**A contribution from technological developments**, estimated on the basis of the additional volumes of oil and gas likely to be recovered by means of new technology.

**A contribution from exploration**, estimated on the basis of the additional volumes of oil and gas likely to be recovered from new discoveries.

Fig 5.4 Oil production and contribution from reserves



It should be emphasized that estimates of the contributions from technological developments and exploration are subject to great uncertainty.

The DEA's estimate of the contribution from technological developments for oil is based on a 5-10 percentage point increase of the average recovery factor. The average recovery factor is the ratio of ultimate recovery to total oil-in-place. Based on the reserves assessment, the average recovery factor for oil is 24 per cent.

It should be noted that an assumption stating that the average recovery factor for oil will increase by about 5-10 percentage points is based on an evaluation of the historical development, as it is impossible to foresee which new techniques will contribute to additional production or to estimate the impact of these techniques on production. Box 5.1 shows an example of technological development.

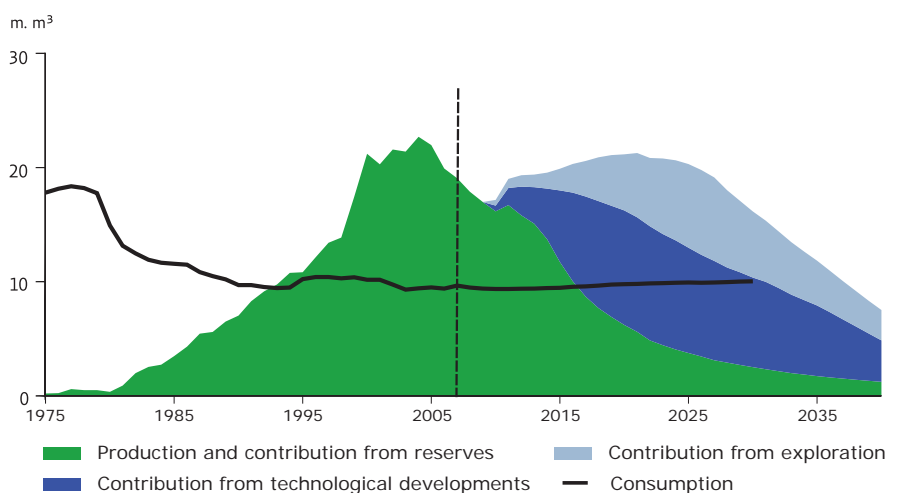
"Energy Strategy 2025" used a contribution from technological developments corresponding to a 5 percentage point increase of the recovery factor, based on the relatively low oil price prevailing at that time. It was also pointed out in the publication that a relatively high oil price would provide a major incentive to develop new techniques. With today's relatively high oil prices, it is estimated that the recovery factor can be increased by 10 percentage points.

It should be emphasized that any new techniques developed must be implemented while the fields are still producing. Once a field has been closed down, introducing new technology is usually not financially viable. This limits the period available for introducing new techniques.

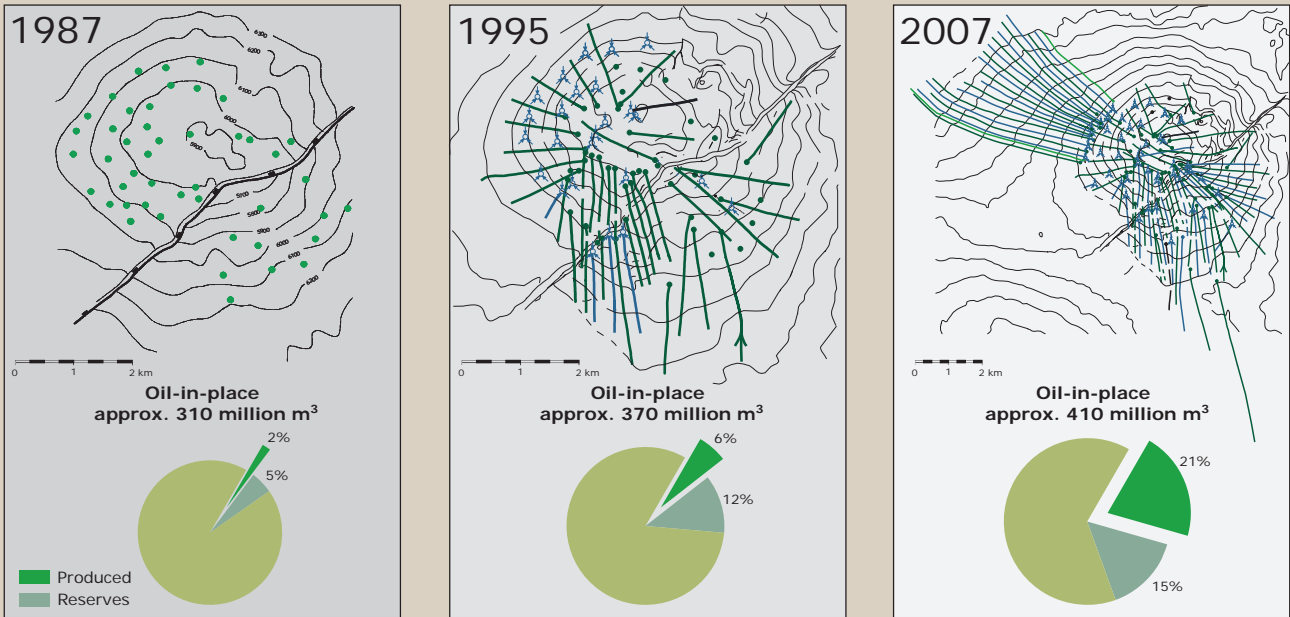
The DEA has based its estimate of the contribution from exploration on an assessment of the exploration potential from mid-2003 made in connection with the 6th Licensing Round.

In mid-2003, the exploration potential was assessed at 205 million m<sup>3</sup> of oil and 152 billion Nm<sup>3</sup> of gas. The report "Oil and Gas Production in 2003" contains a description of the assessment and the method used. In addition, the actual assessment is available at the DEA's website, [www.ens.dk](http://www.ens.dk).

**Fig 5.5** Oil production and production forecast



**Box 5.1** Development of the Dan Field from 1987 to 2007



The Dan Field was brought on stream in 1972 by means of traditional field development where vertical wells were drilled in the crest of the structure. Until 1987, the production strategy consisted of natural depletion by means of vertical wells. The recovery factor was estimated at 7 per cent.

In 1987, the first horizontal well was drilled in the Dan Field, and the horizontal drilling technique was gradually improved in the following years. This method succeeded in increasing production because of the larger contact surface between reservoir and well. At the same time, water-injection tests were initiated to maintain pressure in the reservoir and thus keep the oil flowing towards the production wells.

By 1995, parts of the field had been developed with horizontal wells. In some sections of the field, horizontal production wells were drilled between the vertical wells, several of which have been converted to water injection. In the southern part of the field, horizontal wells were drilled in a pattern of alternate production and injection wells. The effect of this well pattern is that water forces the oil towards the production wells. These initiatives have increased the recovery factor to 18 per cent. The results from the horizontal wells in the flank of the structure have demonstrated that more oil reserves exist in the flank, for which reason the estimate of oil-in-place has been written up.

In 2007, experience drawn from the previous field development has been used to exploit the potential of the northwestern flank, the so-called Western Flank. The recovery factor is now assessed to be 36 per cent, and the estimate of oil-in-place has been further written up.

The hike in the recovery factor estimated for the Dan Field is a prime example of how technological development can impact on a Danish field, and only in the span of 20 years.

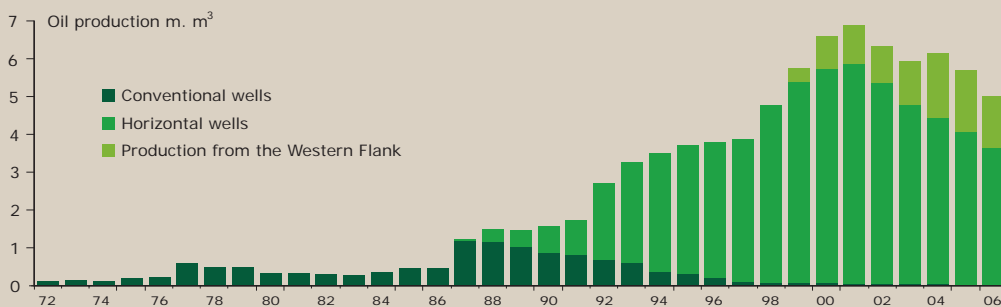
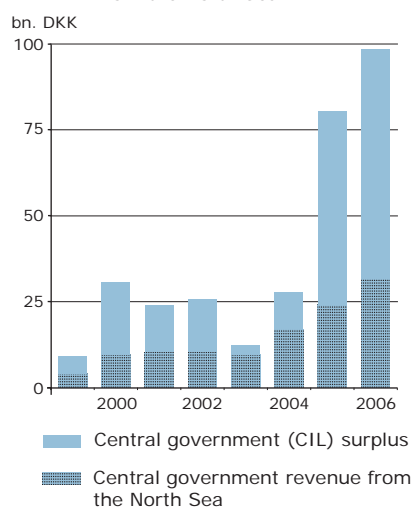


Figure 5.5 illustrates the DEA's oil production forecast when the contributions from reserves, technological developments and exploration are included. It also shows the DEA's most recent consumption forecast. As mentioned above, Denmark is expected to be self-sufficient in oil up to and including 2016, based on the contribution from reserves. If the contributions from technological developments and exploration are included, Denmark is estimated to be self-sufficient in oil for another 20 years or so.

## 6. EDUCATION, RESEARCH AND THE FUTURE

**Fig. 6.1** Central government (CIL) surplus and central government revenue from the North Sea



*Note: The CIL surplus (central government balance on the current, investment and lending account) is the difference between total central government revenue and total central government expenditure.*

In recent years, oil production has become one of the industrial sectors generating most value for the Danish society. The production of oil and natural gas in the North Sea has major impact on the Danish balance of payments and on state revenue; see Figure 6.1. Since 1997, Denmark has been net self-sufficient in energy and is a net exporter of oil and gas today, with the third largest production of oil in Europe.

The bulk of the oil discovered in Denmark to date is deposited in very tight chalk layers. When the production of oil and gas started 35 years ago, only a very small volume of the oil existing in the subsoil was expected to be producible. However, persistent research and development initiatives, particularly within the oil industry, have brought new and improved oil recovery technologies. Greater knowledge of the special properties of chalk is a chief reason for the substantial increase in production.

### Oil for many years to come

After 40 years' intensive exploration in Danish territory, the DEA estimates that about 70 per cent of the oil- and gas-in-place in the Danish part of the Central Graben has been discovered. The most recent licensing round in 2005/06 proved that the oil industry continues to show great interest in the Danish area. The high number of exploration licences granted in the licensing round, 14 in all, signal this interest.

The current oil price level is an incentive to increase the average recovery factor, currently about 25 per cent for Danish fields. A recovery factor of about 35 per cent is expected for some of the major, more intensively developed fields.

For the oil fields in the Danish part of the North Sea, even a small increase in production would produce a noticeable economic effect. An increase of 1 percentage point in the recovery factor would generate an additional production value of about DKK 40 billion, based on an oil price of USD 50 per barrel, which would cover current Danish consumption for a period of two years. Experts do not consider a 10 percentage-point increase unrealistic, assuming that targeted research and development activity is pursued in this area; see also Box 5.1 regarding the Dan Field in the section *Reserves*.

At the same time, the DEA's most recent long-term forecast shows that the oil industry can continue to play a significant role in the Danish economy for at least another 30-40 years; see Figure 5.5 in the section *Reserves*.

In Denmark, the general public has limited awareness of how vital the oil industry is to Danish society and our future prospects. This may be why the educational

### Nanotechnology in oil recovery

A new research department at the University of Copenhagen, the Nano-Science Centre, has set up the framework for the research project *Increasing the recovery of oil from chalk*. The total budget for the project amounts to DKK 59.6 million, with the Danish National Advanced Technology Foundation providing funds of DKK 25.7 million. The aim of the project is to develop new methods for extracting more oil in the North Sea, and the work is jointly carried out between engineers, biologists, physicists, chemists and geologists.

The project is based on collaboration between the Nano-Science Centre and the Department of Geology, the University of Copenhagen and Mærsk Olie og Gas A/S.

programmes considered instrumental to the oil industry's success have experienced declining student enrolment.

### **Demand for manpower**

The oil sector already has a manpower shortage, both in Denmark and abroad. However, this shortage of specialists may become much more pronounced. Within the next 10-15 years, a substantial number of the 5-700 reservoir engineers, geologists and geophysicists in the Danish oil sector will have reached retirement age.

In recent years, a limited number of people have completed training as oil geologists, reservoir engineers or otherwise specialized in exploration and production. But if the oil industry's potential for value creation, export and economic growth is to be exploited in full, a sufficient number of specialists in Danish production technology are necessary.

Recent developments have shown that far too few young people choose a scientific education within this area, despite the good financial and career prospects offered by the sector.

The oil industry employs many people from scientific and technical professional environments, but also people with financial and administrative backgrounds. The interaction between the various professional environments in the oil industry has proved successful and professionally challenging. This cooperation opens up new avenues and provides inspiration for new breakthroughs within almost every professional field.

Many years' targeted research efforts in the oil and gas sector has allowed Denmark to build up attractive educational environments for oil geologists, geophysicists and drilling, reservoir and process engineers, etc.

### **Research in improved oil recovery**

With the existing methods, it is often not possible to extract more than 25-50 per cent of the oil in the North Sea fields. The challenge is to use modern technology to release more oil from the chalk layers in which it is deposited.

### **The oil adheres to the chalk**

The recovery of oil depends on the size of the pores between the chalk particles and how closely the chalk particles are packed together. Current recovery methods drive sea water into a reservoir to force oil out of the pores, but some of the oil adheres to the surface of the chalk particles and in the corners formed between particles. The smaller the particles are, the more corners are formed, so more oil remains behind.

### **Studies of chalk**

For several years, both researchers and oil companies have attempted to increase oil release from chalk particles. The new opportunities have arisen because researchers now have the instruments and expertise needed to study the chalk on the nanometer scale. For example, a nanometer corresponds to one thousandth of the length of a bacterium. The studies are to show how the properties of the chalk particles can be modified to increase oil release.

Employment in the oil industry provides an opportunity for an internationally and professionally challenging career with an attractive salary package. The industry has a promising future, and graduates can easily find employment in the oil industry, both at home and abroad.

**Strategy for research and education**

Research and education can help increase long-term production from Danish oil and gas fields. At the same time, a sufficient number of new specialists must be educated and trained in due time to allow Danish oil and gas resources to be optimally exploited while the existing production and transportation infrastructure in the North Sea still works smoothly; see Figure 6.2.

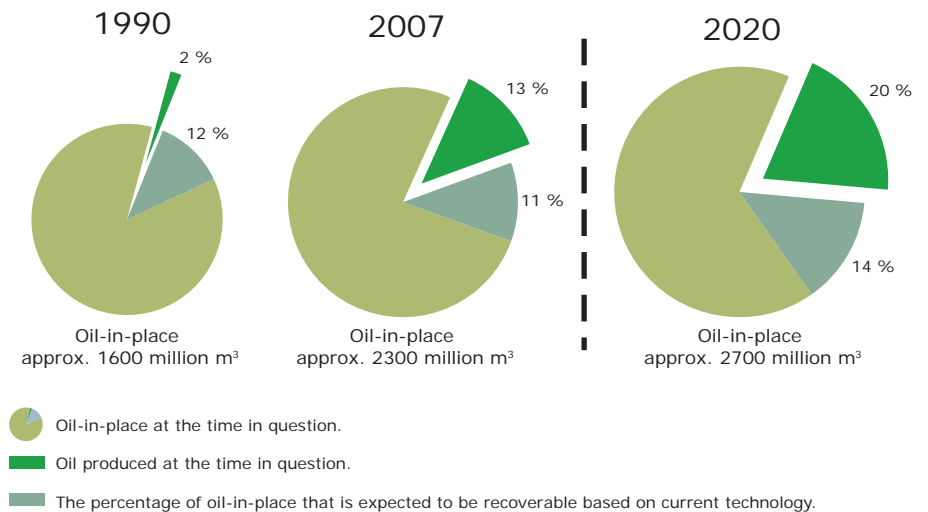
The Danish Government intends to promote expanded cooperation between research and educational environments in the oil and gas area as well as to launch campaigns and disseminate targeted information in cooperation with the industry and educational institutions, the object being to encourage more young people to choose an education aimed at the industry.

Research and educational initiatives must be reinforced quickly so that Danish society can derive the greatest possible benefit from the know-how and competencies possessed by the researchers and specialists working in the sector, and at the same time pass on this knowledge to future specialists.

Therefore, to follow up on “Energy Strategy 2025”, the DEA and the Danish University and Property Agency, assisted by the oil industry and Danish research and educational institutions, have been charged with preparing a new strategy for research and educational initiatives in the areas encompassed by the oil industry.

A steering committee was responsible for implementing the work and put forward a number of recommendations in spring 2007; see Boxes 6.1 and 6.2.

**Fig. 6.2** Amounts of oil-in-place and oil production in 1990 and 2007, plus a 2020 scenario



*Note: The 2020 scenario is based on continued technological developments and new discoveries, and the assumption that the recovery factor can be increased by a further 10 per cent.*

#### Box 6.1

##### **Updated research and educational strategy**

As a follow-up to “Energy Strategy 2025”, the Danish Government has presented a strategy for coherent research, development and educational initiatives in the areas encompassed by the oil industry.

The steering committee in charge of carrying out the work was composed of:

- Executive Vice President Jep Brink from Maersk Oil (Mærskolie og Gas A/S)
- Professor Erling Stenby, the Technical University of Denmark (DTU)
- Head of Department Erik Thomsen, the Geological Survey of Denmark and Greenland (GEUS).
- Director General Peter Helmer Steen, the Danish North Sea Partner (Chairman)

In 2006, the steering committee prepared a background memo about the importance of the oil and gas sector to Denmark, in which the Committee emphasized the significance of access to specialized education and training. The committee also recommended that the standard of existing Danish oil and gas education and training should be assessed and that proposals for possible improvements should be made.

The committee conducted an external evaluation of the relevant educational and training programmes and associated research environments. This evaluation was carried out in cooperation with the DEA and the Ministry of Science, Technology and Innovation and overseen by an international panel of experts from some of the world’s pre-eminent educational establishments within the oil industry.

Both documents are available at [www.ens.dk](http://www.ens.dk)

#### Box 6.2

##### **The steering committee’s recommendations:**

- To increase cooperation between the relatively few and dispersed existing Danish specialized research and educational environments in order to ensure that students are offered coherent oil and gas education and training of high international calibre.
- To use public research funds for oil and gas recovery and production projects of high standard and thereby create/maintain a Danish research and educational environment of high international calibre.
- To launch targeted information campaigns about the educational and career opportunities available to young people within the field of exploration and production of oil and natural gas.

The steering committee’s recommendations and the expert panel’s report are available at [www.ens.dk](http://www.ens.dk)



On the basis of the steering committee's recommendations, the Ministry of Science, Technology and Innovation has opened up a dialogue with the presidencies of the universities. The objective is to ensure that educational programmes for young students in the oil and gas field are coordinated in a targeted fashion and to improve the universities' dialogue with the companies employing the graduates.

The aim is to present a coherent and coordinated picture of the key competencies in the Danish educational system. Establishing a research environment and interdisciplinary cooperation in Denmark is considered an essential means of ensuring students attractive educational programmes of high international calibre in future.

### **The oil industry has a future**

The updated research and educational strategy is to help ensure that the oil and gas activities in the North Sea can continue for several decades to come. This will allow the oil sector to keep contributing to the Danish economy and Danish society.

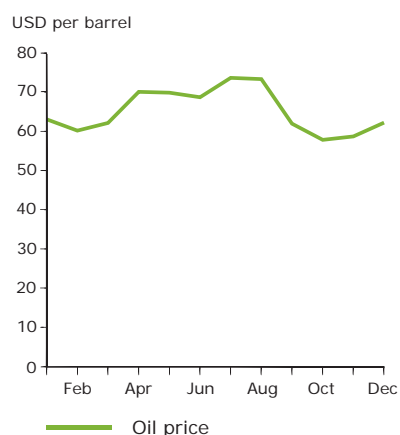
At the same time, oil and gas production is an industry in which Denmark has become an international technology leader in several areas by virtue of the Danish oil industry's innovative ability. The challenging production conditions in the Danish part of the North Sea have demanded great resourcefulness and extensive research and development of new technologies.

This specialized know-how and competencies in challenging and difficult production conditions can take on growing global importance as the world's more easily accessible oil reserves become depleted.

Danish oil companies and subcontractors can increasingly offer their services abroad by virtue of their know-how and experience from Danish oil and gas production activity. This opens up new opportunities for Danish exports and new specialized workplaces worldwide. Consequently, strengthening research, development and educational initiatives within oil and gas production also forms part of the efforts to meet the future requirements of Danish society.

## 7. ECONOMY

Fig. 7.1 Oil price development in 2006



Oil and gas production from the North Sea has an impact on the Danish economy, and thus on the balance of trade and balance of payments, through the Danish state's tax revenue and the profits generated by the players in the oil and gas sector, and not least, it provides jobs for numerous people.

Moreover, the production of hydrocarbons has meant that Denmark has been net self-sufficient in energy since 1997.

### VALUE OF OIL AND GAS PRODUCTION

Three factors influence the value of oil and gas production: the development in production, the international crude oil price and the dollar exchange rate.

The average quotation for a barrel of Brent crude oil was USD 65.1 per barrel in 2006. Thus, the oil price continues the upward trend of previous years, increasing by almost 20 per cent from 2005, when the oil price averaged USD 54.4 per barrel. Figure 7.1 illustrates the oil price development in 2006. The average dollar exchange rate in 2006 was DKK 5.9 per USD, slightly down from the level in 2005.

The value of Danish oil and gas production in 2006 continued climbing as in previous years. According to preliminary estimates for 2006, oil production accounts for about DKK 48.4 billion and gas production for DKK 12.3 billion of the total production value.

Overall, the value of Danish oil and gas production totalled DKK 60.7 billion in 2006, up 10 per cent on the year before. The rise in production value is attributable to the higher oil price, which more than offsets the decline in production and the falling dollar exchange rate.

The breakdown of oil production in 2006 on the ten producing companies in Denmark appears from Figure 2.2 in the section *Development and production*.

The DEA prepares forecasts of the future development of production based on the reserves assessment; see Reserves.

Appendix C contains a detailed outline of financial key figures from 1972 to 2006.

### IMPACT OF PRODUCTION ON THE DANISH ECONOMY

The oil and gas activities have a favourable impact on both the balance of trade and the balance of payments current account. This is because oil and gas production makes Denmark net self-sufficient in energy and also allows for exports. Expanded use of renewable energy, improved energy efficiency and energy savings will make it possible to step up export volumes.

#### The balance of trade for oil and natural gas

Since 1995, Denmark has had a surplus on the balance of trade for oil and gas. The rising oil price level is the main reason why the surplus on the balance of trade for oil and natural gas came to DKK 30.8 billion in 2006. This represents an increase of DKK 6 billion compared to the year before.

#### Impact on the balance of payments

In the past decade, Denmark has been net self-sufficient in energy. In addition, the large production volume results in considerable exports of oil and natural gas.

The DEA prepares an estimate of the impact of oil and gas activities on the balance of payments current account for the next five years on the basis of its own forecasts for production, investments, operating and transportation costs. The underlying calculations are based on a number of assumptions about import content, interest expenses and the oil companies' profits from the hydrocarbon activities.

The DEA's five-year forecast has been prepared for three different oil price scenarios this year. The purpose of preparing three scenarios is to illustrate the sensitivity of balance-of-payments effects to fluctuations in the oil price.

The three scenarios are based on an oil price of USD 30, 50 and 70 per barrel and a dollar exchange rate of DKK 5.82 per USD. An oil price of USD 50 per barrel reflects the IEA's long-term oil price projection.

Table 7.1 shows the individual items used in calculating the impact of oil and gas activities on the balance of payments in the USD 50 oil price scenario. The lower part of the table also shows the calculated impact on the balance of payments current account when using the price scenarios of USD 30 and USD 70 per barrel.

Assuming that the oil price is USD 50 per barrel, the oil and gas activities will have an estimated DKK 26-30 billion impact on the balance of payments current account per year during the period 2007-2011. Moreover, it appears that a higher oil price intensifies the impact, and vice versa.

#### State revenue

The Danish state derives proceeds from North Sea oil and gas production via direct revenue from various taxes and fees: corporate income tax, hydrocarbon tax, royalty, the oil pipeline tariff, compensatory fee and profit sharing.

In addition to the direct revenue from taxes and fees, the Danish state receives indirect revenue from the North Sea by virtue of its shareholding in DONG Energy, generated by the subsidiary DONG E&P A/S' participation in oil and gas activities. In the long term, the state will also receive revenue through the Danish North Sea Fund.

Box 7.1 contains a specification of the state's revenue base in the form of taxes and fees on oil and gas production.

**Table 7.1** Impact of oil/gas activities on the balance of payments, DKK billion, 2006 prices, middle price scenario (50 USD/bbl)

	2007	2008	2009	2010	2011
Production value	42	40	39	38	35
Import content	5	4	4	4	4
Balance of goods and services	37	36	34	34	31
Interest and dividends transferred abroad	8	7	6	5	5
Balance of payments current account	30	29	29	29	26
Balance of payments current account, low price scenario (30 USD/bbl)	20	20	20	20	18
Balance of payments current account, high price scenario (70 USD/bbl)	41	40	39	39	35

*Note: Based on the DEA's five-year forecast*

#### Box 7.1

##### **State revenue from North Sea oil and gas production**

The taxes and fees imposed on the production of oil and gas secure an income for the state. Corporate income tax and hydrocarbon tax are collected by the Central Tax Administration, while the collection of royalty, the oil pipeline tariff and the compensatory fee is administered by the DEA. Moreover, the DEA supervises the metering of the amounts of oil and gas produced on which the assessment of state revenue is based.

Below, an outline is given of the state's sources of revenue, based on the statutory provisions applicable in 2006. Detailed information appears from the DEA's website.

##### **Corporate income tax**

Corporate income tax is the most important source of revenue related to oil and gas. The Danish Government has proposed reducing the corporate income tax rate from 28 per cent to 25 per cent with effect from 1 January 2007. All calculations in this report have been based on a corporate income tax rate of 28 per cent.

##### **Hydrocarbon tax**

This tax was introduced in 1982 with the aim of taxing windfall profits, for example as a result of high oil prices.

##### **Royalty**

Older licences include a condition regarding the payment of royalty, which is payable on the basis of the value of hydrocarbons produced, after deducting transportation costs. New licences contain no requirement for the payment of royalty.

##### **Profit sharing**

With effect from 1 January 2004 and until 8 July 2012, the Concessionaires and their partners under the Sole Concession are to pay 20 per cent of their profits before tax and net interest expenses.

##### **Oil pipeline tariff**

DONG Oil Pipe A/S owns the oil pipeline from the Gorm Field to Fredericia. The users of the oil pipeline pay a fee to DONG Oil Pipe A/S, which includes a profit element of 5 per cent of the value of the crude oil transported. DONG Oil Pipe A/S pays 95 per cent of the proceeds from the 5 per cent profit element to the state, termed the oil pipeline tariff.

##### **Compensatory fee**

Any parties granted an exemption from the obligation regarding connection to and transportation through the oil pipeline are required to pay the state a fee amounting to 5 per cent of the value of the crude oil and condensate comprised by the exemption.

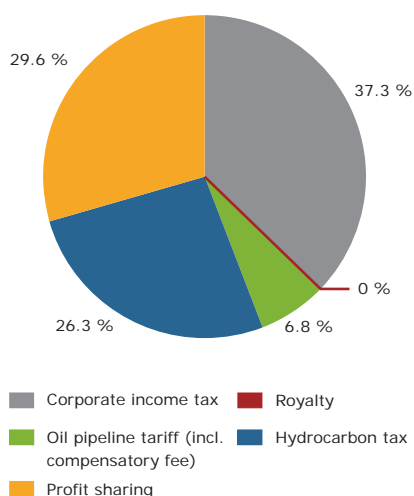
##### **DONG E&P A/S**

DONG E&P A/S is a fully paying participant in the licences granted in the 4th and 5th Licensing Rounds and in the Open Door area, with a 20 per cent share. In some cases, DONG E&P A/S has supplemented this share on commercial terms by purchasing additional licence shares. DONG E&P A/S holds a share in the individual licences on the same terms as the other licensees, and therefore the company pays taxes and fees to the state. Moreover, the dividends on the state's shareholding in DONG Energy are partly generated by oil and gas activities.

##### **Danish North Sea Fund**

In future, the Danish state, represented by the Danish North Sea Fund, will participate in all new licences with a 20 per cent share. This also applies to the 14 licences issued in the 6th Licensing Round on 22 May 2006.

**Fig. 7.2** State revenue in 2006



With a share of about 37 per cent, corporate income tax is the chief source of state revenue. Figure 7.2 shows the breakdown of state tax revenue in 2006. State revenue from hydrocarbon production in the North Sea aggregated about DKK 155.8 billion in 2006 prices in the period 1963-2006. Figure 7.3 shows the development in state revenue from 1973 to 2006. By way of illustration, the associated production value totalled almost DKK 477.5 billion during the same period.

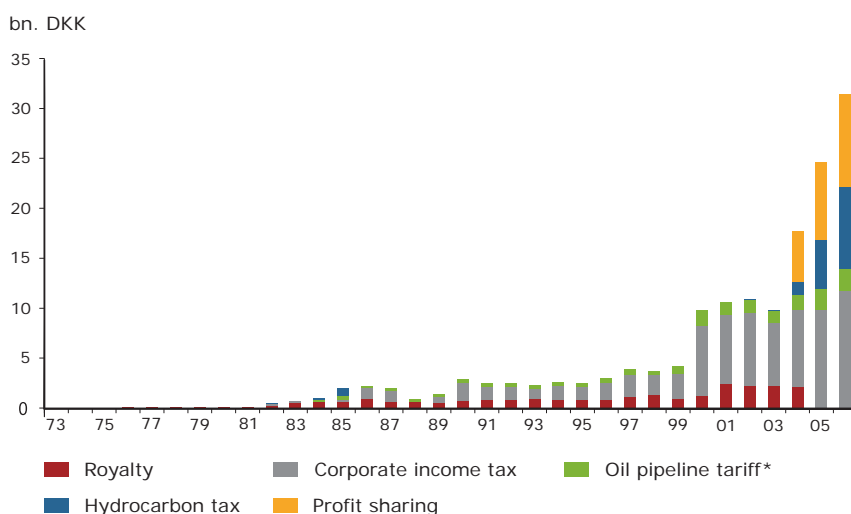
Table 7.2 shows the development in total state revenue for the past five years, broken down on the individual taxes and fees. On the basis of the Danish Ministry of Taxation's calculations, the DEA estimates that tax revenue grew by slightly more than DKK 7.3 billion from 2005 to 2006, an increase of about 30 per cent.

In September 2003, the Danish Government concluded an agreement with A.P. Møller Mærsk, the North Sea Agreement. This agreement changed the eligibility for tax deductions and resulted in a steeper progressive tax rate. This means that the higher profits the companies generate, the higher the proportion they have to pay in tax. Consequently, higher oil prices result in increased revenue for the state. Higher production will also yield more state revenue, given unchanged oil prices. The development in state revenue from taxes and fees reflects this restructuring of the tax system.

For the next five years, the Ministry of Taxation estimates that the state's revenue will total about DKK 17-20 billion per year from 2007 to 2011, based on the USD 50 oil price scenario. Table 7.3 shows the development in expected state revenue for the three different oil price scenarios.

It should be noted that future estimates of corporate income tax and hydrocarbon tax payments are subject to uncertainty with respect to oil prices, production volumes and the dollar exchange rate. In addition, uncertainty attaches to the calculations because they are based on various stylized assumptions, some of which concern the companies' finance costs. A corporate income tax rate of 28 per cent was used in making the calculations.

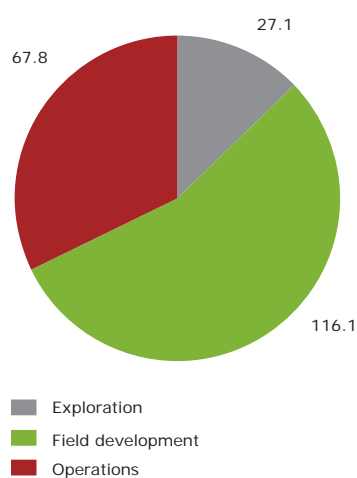
**Fig. 7.3** Development in total state revenue from oil/gas production 1973-2006, DKK billion, 2006 prices



\* Incl. compensatory fee

Note: Accrual according to the Finance Act (year of payment)

**Fig. 7.4** Total costs of all licensees, 1963-2006 DKK billion, 2006 prices



**Table 7.2** State revenue over the past five years, DKK million, nominal prices

	2002	2003	2004	2005	2006*
Hydrocarbon tax	65	64	1,251	4,854	8,282
Corporate income tax	6,794	5,943	7,351	9,661	11,738
Royalty	2,110	2,181	2,104	1	2
Oil pipeline tariff**	1,169	1,144	1,496	2,052	2,156
Profit sharing	-	-	4,890	7,595	9,315
<b>Total</b>	<b>10,138</b>	<b>9,331</b>	<b>17,092</b>	<b>24,163</b>	<b>31,493</b>

\* Estimate

\*\* Incl. 5 per cent compensatory fee

Note: Accrual according to the Finance Act (year of payment)

## FINANCIAL DATA FOR THE LICENSEES

In the same way that oil prices impact on state revenue from production in the North Sea, the licensees' initiatives play a vital role in both the current and future activity level and thus potential revenue.

Investments in the development of existing and new fields account for more than half the licensees' total expenses. During the period from 1963 to 2006, the licensees' total expenses amounted to DKK 211 billion, broken down as shown in Figure 7.4. The expenses for exploration, field developments and operations (including administration and transportation) accounted for 13, 55 and 32 per cent, respectively, of total expenses.

### Exploration costs

For 2006, total exploration costs are preliminarily estimated at DKK 0.8 billion. Thus, the total costs of exploration increased compared to 2005, when exploration costs were calculated at DKK 0.5 billion.

**Table 7.3** Expected state revenue from oil and gas production, DKK billion, nominal prices\*

		2007	2008	2009	2010	2011
Corporate income tax	70 USD/bbl	11.7	11.1	10.7	10.1	10.6
	50 USD/bbl	7.6	7.2	6.8	6.3	6.6
	30 USD/bbl	3.5	3.3	3.0	2.7	2.6
Hydrocarbon tax	70 USD/bbl	9.4	8.9	8.8	8.3	8.2
	50 USD/bbl	5.3	4.9	4.9	4.5	4.5
	30 USD/bbl	1.2	0.9	1.0	0.7	0.7
Profit sharing	70 USD/bbl	9.4	9.0	8.8	8.4	8.2
	50 USD/bbl	6.2	5.9	5.8	5.5	5.4
	30 USD/bbl	3.1	2.9	2.9	2.6	2.5
Royalty	70 USD/bbl	0.0	0.0	0.0	0.0	0.0
	50 USD/bbl	0.0	0.0	0.0	0.0	0.0
	30 USD/bbl	0.0	0.0	0.0	0.0	0.0
Oil pipeline tariff**	70 USD/bbl	2.3	2.1	2.1	2.0	2.1
	50 USD/bbl	1.6	1.5	1.5	1.4	1.5
	30 USD/bbl	1.0	0.9	0.9	0.9	0.9
<b>Total</b>	70 USD/bbl	32.6	31.2	30.4	28.8	29.2
	50 USD/bbl	20.7	19.6	19.0	17.8	17.9
	30 USD/bbl	8.7	8.0	7.7	6.9	6.7

\* Assumed annual inflation rate of 1.8 per cent

\*\* Incl. 5 per cent compensatory fee

Source: Ministry of Taxation

Note: Based on the DEA's five-year forecast

The increase is partly attributable to the new licences awarded in the 6th Licensing Round. This is also why the DEA expects annual exploration costs to total DKK 0.7-0.8 billion until 2008. After that, exploration costs are projected to drop to a lower level, based on the existing assumptions.

### Investments in field developments

The largest expense item in the licensees' budget is the development of new and existing fields. Investments in field developments are estimated to total DKK 5.6 billion in 2006, an increase of DKK 1.5 billion on the previous year. By comparison, annual investments in field developments averaged about DKK 5.1 billion in the past ten years. Table 7.4 illustrates investments in field developments over the period 2002-2006.

As in 2005, the development activities in the Dan, Halfdan, Tyra and Valdemar Fields represented the bulk of investments in 2006. Development activities in these fields accounted for slightly more than 80 per cent of total investments in 2006. When considering the five-year period 2002-2006, the development projects in the Dan, Halfdan, Nini, South Arne and Tyra Fields represented about 70 per cent of total investment activity.

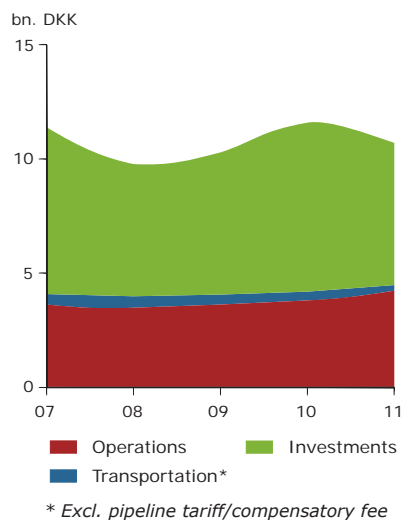
Table 7.5 shows the DEA's estimate of development activity for the period from 2007 to 2011. The estimate is based on ongoing, approved, planned and possible investments. The forecast of possible field development activities is based on the DEA's assessment of the potential for initiating further production in the short term beyond the production for which development plans have already been submitted; see the section *Reserves*.

**Table 7.4** Investments, DKK million, nominal prices

	2002	2003	2004	2005	2006*
Cecilie	223	660	309	(18)	4
Dagmar	-	-	-	-	148
Dan	437	943	750	750	684
Gorm	242	107	108	291	304
Halfdan	2,412	1,779	1,124	683	1,293
Harald	0	4	22	53	1
Kraka	3	-	2	-	-
Nini	285	1,288	319	163	19
Roar	-	-	-	-	-
Rolf	-	37	4	-	1
Siri	111	406	425	73	140
Skjold	5	77	8	11	4
South Arne	849	764	762	310	451
Svend	223	-	-	-	-
Tyra	85	305	459	1,020	1,520
Tyra Southeast	569	82	96	45	-
Valdemar	(1)	200	52	553	992
NOGAT pipeline	-	766	664	12	-
Not allocated	31	(31)	2	5	97
<b>Total</b>	<b>5,475</b>	<b>7,386</b>	<b>5,105</b>	<b>3,951</b>	<b>5,658</b>

\* Estimate

**Fig. 7.5** Investments in fields, operating and oil transportation costs, 2006 prices



Compared to 2005, the DEA has written up its estimate of investments for the period 2007-2011. This is due to the higher activity level expected for some of the fields, particularly the existing fields Dan, Halfdan, South Arne, Tyra and Valdemar as well as the new Hejre Field.

#### Operating, administration and transportation costs

For 2006, the DEA has calculated operating, administration and transportation costs at DKK 4.1 billion. Thus, the upward trend of recent years continues, in part because higher oil prices have driven up costs.

Figure 7.5 illustrates the DEA's estimate of developments in investments and operating and transportation costs for the period 2007-2011. Operating costs are expected to climb during the whole period, while transportation costs are estimated to remain at the same level as in 2006 and to decline from 2011 onwards. Investments are projected to reach a slightly higher level than in 2006.

**Table 7.5** Estimated investments in development projects, 2007-2011, DKK billion, 2006 prices

	2007	2008	2009	2010	2011
<b>Ongoing and approved</b>					
Adda	-	0.1	0.6	-	-
Alma	-	0.6	0.5	-	-
Boje	-	-	-	0.8	-
Cecilie	-	-	-	-	-
Dagmar	-	-	-	-	-
Dan	0.9	0.6	-	-	-
Elly	0.3	1.6	-	-	-
Gorm	0.1	0.0	-	-	-
Halfdan	2.0	0.9	0.1	-	-
Harald	0.0	0.1	-	-	-
Kraka	0.3	-	-	-	-
Lulita	-	-	-	-	-
Nini	0.1	-	-	-	-
Regnar	-	-	-	-	-
Roar	-	-	-	-	-
Rolf	-	-	-	-	-
Siri	0.3	-	-	-	-
Skjold	-	-	-	-	-
South Arne	0.8	-	-	-	-
Svend	-	-	-	-	-
Tyra	0.4	0.4	0.4	0.0	1.3
Tyra Southeast	0.5	-	-	-	-
Valdemar	1.6	0.7	-	-	-
<b>Total</b>	<b>7.3</b>	<b>5.1</b>	<b>1.5</b>	<b>0.8</b>	<b>1.3</b>
Planned	-	-	-	-	0.8
Possible	-	0.7	4.7	6.6	4.0
<b>Expected</b>	<b>7.3</b>	<b>5.8</b>	<b>6.2</b>	<b>7.4</b>	<b>6.2</b>



Box 7.2

**The North Sea Agreement**

On 29 September 2003, the Danish state entered into an agreement, the North Sea Agreement, with A.P. Møller Mærsk regarding a continuation of the Sole Concession until 2042. The agreement laid down the future framework for activities in the North Sea. This involved a restructuring of the tax system and 20 per cent state participation in the Sole Concession as from 9 July 2012.

The North Sea Agreement entered into force on 1 January 2004 and thus has a term of almost 40 years. To provide the best possible decision-making basis when concluding the agreement, the Danish state calculated the consequences of an agreement.

These calculations were based on a number of assumptions, for instance regarding oil production, oil prices, investments, etc. These assumptions were the cornerstones of the calculations, building on knowledge accumulated up to 2002. As the actual development of the activities is difficult to predict, sensitivity analyses were also made by changing the central parameters. Oil production volumes and oil prices are the parameters with the greatest impact on state revenue and the companies' earnings from the North Sea.

The development in these parameters since the conclusion of the agreement, as compared to the assumptions used when negotiating the North Sea Agreement, is outlined below. The development is illustrated by means of the actual and estimated values for 2004-2006 and the DEA's most recent forecast for 2007-2011.

**Oil production**

Three production scenarios were drawn up for the purpose of the calculations, a low, middle and high scenario:

- **Low scenario:** New technological developments or new discoveries are not included.
- **Middle scenario (main scenario):** This scenario was used as the basis for negotiations. It was assumed that production could be increased by means of technological developments. Further, it was assumed that production from a new medium-sized oil discovery could be initiated around 2012. Overall, production was assumed to increase by an average of 1.2 per cent per year, compared to the DEA's 20-year forecast then existing for the period 2003-2022.
- **High scenario:** In addition to the assumptions underlying the middle scenario, this scenario was based on yet another medium-sized discovery and faster technological development. Overall, production was assumed to increase by an average of 2.1 per cent per year, relative to the DEA's 20-year forecast for the period 2003-2022.

Fig. 7.6 Development in production relative to the production scenarios of the North Sea Agreement

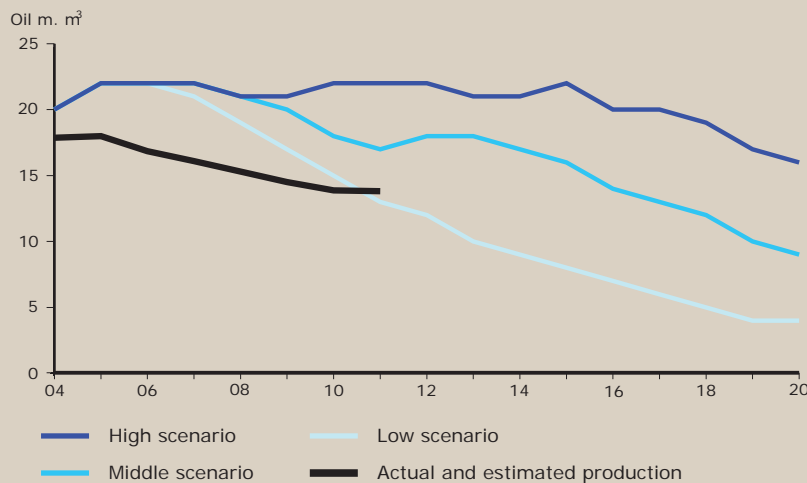


Figure 7.6 shows how the actual and estimated production developed compared to these scenarios. As appears from the figure, production was significantly lower than assumed in all three scenarios. Actual production figures for 2004-2006 were lower than assumed in 2003. The DEA's estimate proved too optimistic for a number of reasons, inter alia that some development projects were abandoned or postponed because the production estimates for the projects had been written down.

However, in the DEA's opinion, postponement of production from the relevant fields was the primary factor. Thus, according to the most recent production forecast, the production figure for 2011 is expected to reach the production volume assumed in the low scenario.

### Oil price

To provide for the uncertainty associated with the oil price development, six price sensitivity scenarios were prepared to supplement the middle scenario.

Figure 7.7 shows how the actual and estimated oil price developed compared to these oil price scenarios. It appears from the figure that the oil price in 2005 ranged between the two highest oil price sensitivity scenarios and was thus significantly higher than assumed in the middle scenario.

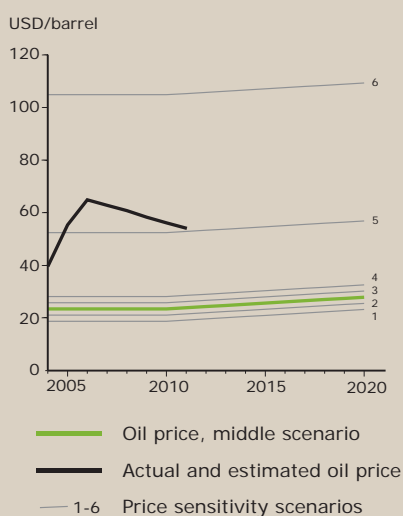
### Middle scenario (main scenario) and central parameters

Naturally, feasibility studies include more parameters than the two mentioned above. Figure 7.8 depicts a bar chart showing the various parameters compared to the assumptions made in the middle scenario.

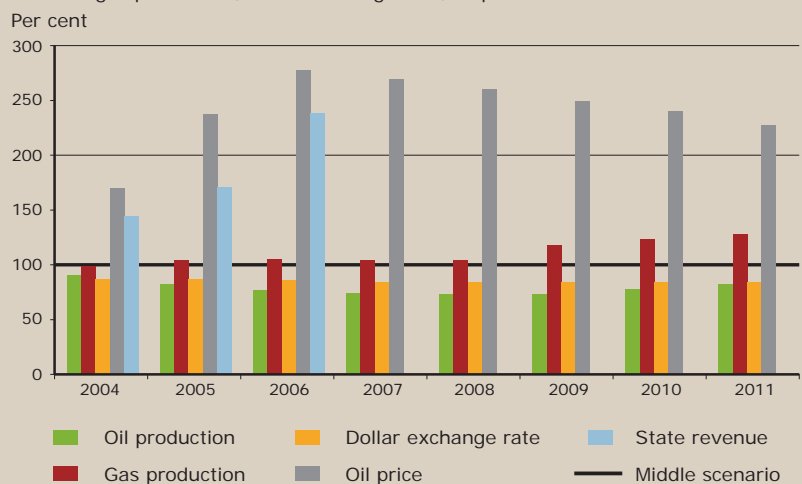
As appears from the figure, the level of oil production and the dollar exchange rate are lower than assumed in the middle scenario. Gas production is at the level assumed in the middle scenario and is estimated to exceed it slightly, whereas the oil price and state revenue are much higher than assumed. In relation to state revenue, this means that the current level of the oil price helps offset the impact of lower production.

This development illustrates very clearly how difficult it is to predict the actual course of events. For the two main parameters, the actual effect on state revenue is opposite. The lower production volume has a negative impact on total earnings, while the higher oil price level has a positive impact.

**Fig. 7.7** Oil price development relative to assumptions in the North Sea Agreement



**Fig. 7.8** Outline of assumptions in the North Sea Agreement showing percentage deviation relative to the middle scenario (100 per cent) for oil production, gas production, dollar exchange rate, oil price and state revenue.



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## APPENDIX A: AMOUNTS PRODUCED AND INJECTED

### Production and sales

**OIL** thousand cubic metres

	1972-96	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
<b>Dan</b>	29,374	3,858	4,767	5,745	6,599	6,879	6,326	5,929	6,139	5,712	5,021	86,349
<b>Gorm</b>	27,746	3,045	2,865	3,384	3,110	2,180	2,887	2,838	2,469	1,978	1,897	54,400
<b>Skjold</b>	23,336	2,011	1,896	1,825	1,975	1,354	1,659	1,532	1,443	1,310	1,214	39,556
<b>Tyra</b>	14,433	1,263	931	892	1,000	872	801	918	723	773	845	23,450
<b>Rolf</b>	3,279	96	92	77	83	51	51	104	107	79	89	4,109
<b>Kraka</b>	2,039	315	314	404	350	253	157	139	199	211	222	4,602
<b>Dagmar</b>	938	17	13	10	8	4	6	7	2	0	0	1,005
<b>Regnar</b>	701	27	43	29	14	33	18	19	19	16	11	930
<b>Valdemar</b>	684	159	95	86	77	181	353	435	491	423	470	3,454
<b>Roar</b>	320	427	327	259	285	317	175	121	98	94	51	2,474
<b>Svend</b>	836	1,356	635	521	576	397	457	280	326	324	296	6,002
<b>Harald</b>	-	794	1,690	1,332	1,081	866	578	425	314	237	176	7,493
<b>Lulita</b>	-	-	143	224	179	66	24	20	19	35	68	778
<b>Halfdan</b>	-	-	-	222	1,120	2,965	3,718	4,352	4,946	6,200	6,085	29,608
<b>Siri</b>	-	-	-	1,593	2,118	1,761	1,487	925	693	703	595	9,875
<b>South Arne</b>	-	-	-	757	2,558	2,031	2,313	2,383	2,257	2,371	1,869	16,539
<b>Tyra SE</b>	-	-	-	-	-	-	493	343	580	614	446	2,475
<b>Cecilie</b>	-	-	-	-	-	-	-	166	310	183	116	774
<b>Nini</b>	-	-	-	-	-	-	-	391	1,477	623	377	2,869
<b>Total</b>	<b>103,687</b>	<b>13,367</b>	<b>13,810</b>	<b>17,362</b>	<b>21,134</b>	<b>20,207</b>	<b>21,505</b>	<b>21,327</b>	<b>22,612</b>	<b>21,886</b>	<b>19,847</b>	<b>296,744</b>

### Production

**GAS** million normal cubic metres

	1972-96	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
<b>Dan</b>	11,262	1,116	1,343	1,410	1,186	1,049	945	786	764	651	561	21,075
<b>Gorm</b>	11,086	609	633	537	426	306	480	339	216	218	207	15,056
<b>Skjold</b>	2,062	189	146	154	158	104	123	92	77	93	77	3,274
<b>Tyra</b>	38,631	4,229	3,638	3,878	3,826	3,749	3,948	3,994	4,120	3,745	3,792	77,552
<b>Rolf</b>	138	4	4	3	4	2	2	4	5	3	4	172
<b>Kraka</b>	611	85	106	148	119	100	52	25	23	24	28	1,320
<b>Dagmar</b>	141	3	2	2	2	1	1	3	2	0	0	158
<b>Regnar</b>	44	2	4	2	1	3	1	2	2	1	1	63
<b>Valdemar</b>	234	89	54	49	55	78	109	151	218	208	208	1,453
<b>Roar</b>	1,332	1,964	1,458	1,249	1,407	1,702	1,052	915	894	860	489	13,322
<b>Svend</b>	85	152	84	65	75	48	61	43	38	34	28	712
<b>Harald</b>	-	1,092	2,741	2,876	2,811	2,475	2,019	1,563	1,232	1,091	927	18,827
<b>Lulita</b>	-	-	69	181	160	27	6	5	5	13	38	503
<b>Halfdan</b>	-	-	-	37	178	522	759	1,142	1,449	2,582	2,948	9,617
<b>Siri</b>	-	-	-	142	197	176	157	110	63	115	58	1,017
<b>South Arne</b>	-	-	-	167	713	774	681	544	461	484	366	4,190
<b>Tyra SE</b>	-	-	-	-	-	-	447	452	1,233	1,337	1,108	4,577
<b>Cecilie</b>	-	-	-	-	-	-	-	14	24	15	8	61
<b>Nini</b>	-	-	-	-	-	-	-	29	107	49	29	215
<b>Total</b>	<b>65,625</b>	<b>9,534</b>	<b>10,281</b>	<b>10,901</b>	<b>11,316</b>	<b>11,116</b>	<b>10,844</b>	<b>10,213</b>	<b>10,934</b>	<b>11,523</b>	<b>10,878</b>	<b>173,165</b>

The monthly production figures for 2006 are available at the DEA's website [www.ens.dk](http://www.ens.dk)

**Fuel\***
**GAS** million normal cubic metres

	1972-96	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
<b>Dan</b>	617	109	148	172	179	184	182	198	201	205	218	2,413
<b>Gorm</b>	1,144	164	152	149	142	111	146	135	137	124	124	2,529
<b>Tyra</b>	1,205	210	224	239	229	243	245	242	249	247	241	3,575
<b>Dagmar</b>	21	-	-	-	-	-	-	-	-	-	-	21
<b>Harald</b>	-	5	14	14	13	10	9	8	8	7	8	96
<b>Siri</b>	-	-	-	8	21	22	21	20	19	21	25	158
<b>South Arne</b>	-	-	-	3	32	34	45	49	45	52	53	313
<b>Halfdan</b>	-	-	-	-	-	-	-	-	20	39	39	98
<b>Total</b>	<b>2,987</b>	<b>488</b>	<b>539</b>	<b>585</b>	<b>618</b>	<b>604</b>	<b>648</b>	<b>652</b>	<b>679</b>	<b>694</b>	<b>709</b>	<b>9,203</b>

**Flaring\***

	1972-96	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
<b>Dan</b>	1,497	36	43	56	67	79	55	71	37	23	29	1,993
<b>Gorm</b>	1,005	81	71	71	66	88	81	66	57	61	61	1,709
<b>Tyra</b>	533	46	42	58	58	68	61	54	63	55	51	1,089
<b>Dagmar</b>	118	3	2	2	2	1	1	3	2	0	0	135
<b>Harald</b>	-	77	19	12	7	11	3	1	1	1	2	135
<b>Siri</b>	-	-	-	73	9	15	9	23	65	15	7	215
<b>South Arne</b>	-	-	-	114	41	9	11	12	11	14	11	223
<b>Halfdan</b>	-	-	-	-	-	-	-	4	25	16	20	64
<b>Total</b>	<b>3,154</b>	<b>243</b>	<b>177</b>	<b>386</b>	<b>250</b>	<b>270</b>	<b>222</b>	<b>234</b>	<b>262</b>	<b>185</b>	<b>181</b>	<b>5,563</b>

**Injection**

	1972-96	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
<b>Gorm</b>	7,977	62	24	25	45	4	14	6	4	3	0	8,164
<b>Tyra</b>	12,526	1,778	2,908	3,074	3,104	2,773	2,535	2,312	1,612	1,285	761	34,667
<b>Siri**</b>	-	-	-	61	167	139	126	109	111	143	66	922
<b>Total</b>	<b>20,503</b>	<b>1,840</b>	<b>2,933</b>	<b>3,160</b>	<b>3,316</b>	<b>2,916</b>	<b>2,675</b>	<b>2,428</b>	<b>1,727</b>	<b>1,431</b>	<b>827</b>	<b>43,753</b>

**Sales\***

	1984-96	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
<b>Dan</b>	9,802	1,058	1,261	1,371	1,238	1,412	1,521	1,679	1,635	1,750	1,810	24,536
<b>Gorm</b>	3,159	495	535	448	334	209	364	228	99	126	103	6,101
<b>Tyra</b>	26,017	4,400	2,060	1,870	1,971	2,493	2,776	2,948	4,580	4,598	4,574	58,287
<b>Harald</b>	-	1,010	2,777	3,032	2,950	2,482	2,013	1,558	1,228	1,096	954	19,099
<b>South Arne</b>	-	-	-	50	640	730	625	483	406	418	302	3,655
<b>Halfdan</b>	-	-	-	-	-	-	-	4	319	1,226	1,421	2,971
<b>Total</b>	<b>38,981</b>	<b>6,963</b>	<b>6,633</b>	<b>6,770</b>	<b>7,133</b>	<b>7,326</b>	<b>7,299</b>	<b>6,900</b>	<b>8,267</b>	<b>9,214</b>	<b>9,164</b>	<b>114,647</b>

\* The names refer to processing centres.

\*\* Gas from the Cecilie and Nini Fields is injected into the Siri Field.

## Production

**CO<sub>2</sub> EMISSIONS** thousand tons

	1972-96	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
<b>Fuel</b>	6,800	1,110	1,226	1,343	1,476	1,459	1,577	1,591	1,642	1,694	1,675	21,592
<b>Flaring</b>	7,179	553	402	1,126	645	646	535	564	664	457	470	13,242
<b>Total</b>	<b>12,979</b>	<b>1,664</b>	<b>1,628</b>	<b>2,469</b>	<b>2,122</b>	<b>2,104</b>	<b>2,112</b>	<b>2,154</b>	<b>2,306</b>	<b>2,151</b>	<b>2,144</b>	<b>33,833</b>

CO<sub>2</sub> emissions from the use of diesel oil have not been included.

CO<sub>2</sub> emissions have been calculated on the basis of parameters specific to the individual year and the individual installation.

In 2006, the calculation was based on verified CO<sub>2</sub> emission data from reports filed under the Danish Act on CO<sub>2</sub> Allowances and included CO<sub>2</sub> emissions from diesel combustion.

## Production

**WATER** thousand cubic metres

	1972-96	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
<b>Dan</b>	6,225	1,845	2,976	4,220	5,277	6,599	6,348	7,183	8,053	9,527	10,936	69,190
<b>Gorm</b>	9,247	2,906	3,177	3,468	3,980	3,353	4,017	4,420	5,173	5,252	4,822	49,815
<b>Skjold</b>	6,174	3,635	3,938	3,748	4,333	2,872	3,007	3,525	3,688	4,270	4,328	43,517
<b>Tyra</b>	8,050	2,215	2,020	2,033	3,046	2,545	2,261	3,039	2,977	3,482	3,150	34,818
<b>Rolf</b>	2,403	390	411	366	358	181	168	270	308	290	316	5,460
<b>Kraka</b>	1,081	287	347	329	256	352	306	208	426	320	297	4,209
<b>Dagmar</b>	1,950	408	338	246	241	102	160	375	90	3	0	3,914
<b>Regnar</b>	939	164	407	363	139	475	257	316	396	352	255	4,063
<b>Valdemar</b>	78	61	52	55	48	150	272	310	325	792	937	3,079
<b>Roar</b>	14	96	146	199	317	386	301	476	653	662	498	3,748
<b>Svend</b>	2	64	272	582	1,355	954	1,051	1,330	1,031	1,309	1,205	9,156
<b>Harald</b>	-	-	5	15	39	98	78	43	15	12	12	318
<b>Lulita</b>	-	-	3	5	11	23	14	14	15	38	92	215
<b>Halfdan</b>	-	-	-	56	237	493	367	612	2,099	2,825	3,460	10,149
<b>Siri</b>	-	-	-	319	1,868	2,753	3,041	2,891	1,648	1,692	2,032	16,243
<b>South Arne</b>	-	-	-	15	58	112	370	855	1,105	1,781	1,730	6,026
<b>Tyra SE</b>	-	-	-	-	-	-	250	596	466	437	377	2,126
<b>Cecilie</b>	-	-	-	-	-	-	-	25	331	637	651	1,644
<b>Nini</b>	-	-	-	-	-	-	-	3	63	729	822	1,618
<b>Total</b>	<b>36,163</b>	<b>12,072</b>	<b>14,093</b>	<b>16,020</b>	<b>21,564</b>	<b>21,449</b>	<b>22,267</b>	<b>26,491</b>	<b>28,860</b>	<b>34,410</b>	<b>35,919</b>	<b>269,307</b>

## Injection

	1972-96	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
<b>Dan</b>	20,775	8,654	11,817	14,964	17,464	18,176	16,123	18,063	20,042	20,281	21,520	187,878
<b>Gorm</b>	24,479	8,642	8,376	8,736	10,641	6,549	8,167	7,066	7,551	7,251	6,544	104,003
<b>Skjold</b>	31,403	6,320	6,291	5,866	6,520	4,805	6,411	6,386	6,451	6,045	5,711	92,208
<b>Halfdan</b>	-	-	-	82	13	620	2,532	5,162	5,759	9,710	11,026	34,905
<b>Siri</b>	-	-	-	1,236	3,778	4,549	4,507	3,383	1,681	1,347	1,923	22,404
<b>South Arne</b>	-	-	-	-	52	1,991	4,397	5,316	4,947	5,608	5,362	27,672
<b>Nini</b>	-	-	-	-	-	-	-	71	916	502	912	2,401
<b>Cecilie</b>	-	-	-	-	-	-	-	-	87	194	30	311
<b>Total</b>	<b>76,657</b>	<b>23,616</b>	<b>26,484</b>	<b>30,884</b>	<b>38,469</b>	<b>36,689</b>	<b>42,138</b>	<b>45,446</b>	<b>47,435</b>	<b>50,937</b>	<b>53,027</b>	<b>471,782</b>

Water injection includes the injection of produced water and seawater. Most of the water produced in the Gorm, Skjold, Dagmar and Siri Fields is reinjected.

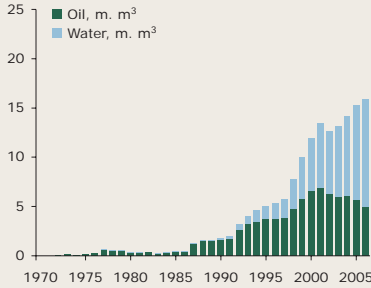
# APPENDIX B: PRODUCING FIELDS

## Explanation of field data

### PRODUCTION

Cum. production at 1 January 2007

Oil: 86.35 m. m<sup>3</sup>  
 Gas: 21.08 bn. Nm<sup>3</sup>  
 Water: 69.19 m. m<sup>3</sup>



Production of oil, gas and water

The chart shows the primary production from the individual fields, i.e. oil or gas. The figures show the cumulative production of oil, gas and water until 1 January 2007.

**Oil field (e.g. Dan, Halfdan, Siri)** ■ Oil, m. m<sup>3</sup> ■ Gas, bn. Nm<sup>3</sup> ■ Water, m. m<sup>3</sup>

At the time of production startup, the percentage of oil produced is high, but over time, the percentage of water produced increases. When oil flows from the reservoir to the surface, it degasses and the amount of gas produced also decreases.

**Gas field (e.g. Harald)** ■ Oil and condensate, m. m<sup>3</sup> ■ Gas, bn. Nm<sup>3</sup> ■ Water, m. m<sup>3</sup>

Production from a gas field consists of gas, water and condensate, which is a light oil. Due to the pressure difference between reservoir and surface, the gas condenses at the surface, which means that liquid hydrocarbons (condensate) are also produced.

**Oil and gas field (e.g. Tyra Southeast)** ■ Oil and condensate, m. m<sup>3</sup> ■ Gas, bn. Nm<sup>3</sup> ■ Water, m. m<sup>3</sup>

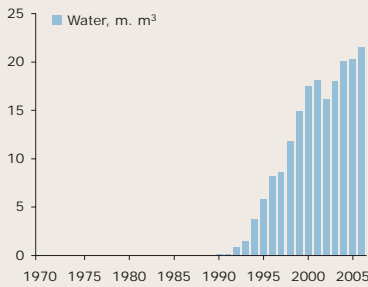
The production of oil, gas, condensate and water.

The production figures for 2006 appear from Appendix A.

### INJECTION

Cum. injection at 1 January 2007

Water: 187.88 m. m<sup>3</sup>



Injection of water and gas

The chart shows the primary injection in the individual fields, i.e. water or gas. The figures show the cumulative injection of water and gas until 1 January 2007. The injection method is not used for all fields.

Injecting water into oil reservoirs maintains the pressure while forcing oil towards the production wells. The injection of gas also maintains pressure in the reservoir, but affects the viscosity of hydrocarbons at the same time.

**Fields with water injection (e.g. Halfdan, South Arne)** ■ Water, m. m<sup>3</sup>

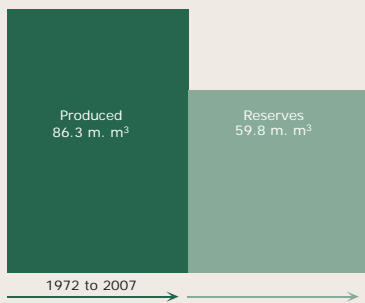
In the Halfdan Field, for example, water is injected to displace the oil towards the production wells.

**Fields with gas injection (e.g. Tyra)** ■ Gas, bn. Nm<sup>3</sup>

In a few fields, gas is injected to optimize the production of liquid hydrocarbons.

### RESERVES

Oil: 59.8 m. m<sup>3</sup>  
 Gas: 6.3 bn. Nm<sup>3</sup>



Reserves compared to cumulative production

Figures for oil and gas reserves are indicated for each individual field.

The chart shows the relationship between the amounts produced until 1 January 2007 and the estimated hydrocarbons-in-place, the reserves.

**Produced**

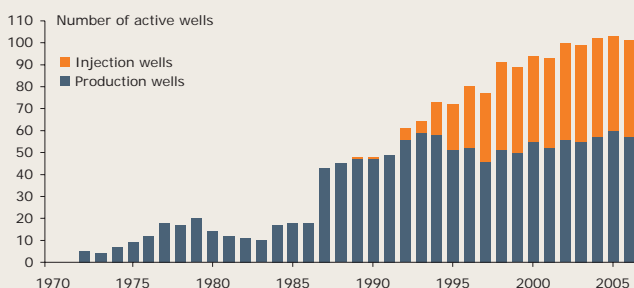
The cumulative production of oil or gas until 1 January 2007.

**Reserves**

The estimated amounts of oil and gas that can be recovered by means of known technology under the prevailing economic conditions.

### DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
 2006 prices DKK 25.9 billion



#### Development and investment

Total investments comprise the costs of developing installations and wells.

The chart shows the number of active wells in the individual years. Thus, wells that are closed in throughout a year will not be included in the figures for that year.

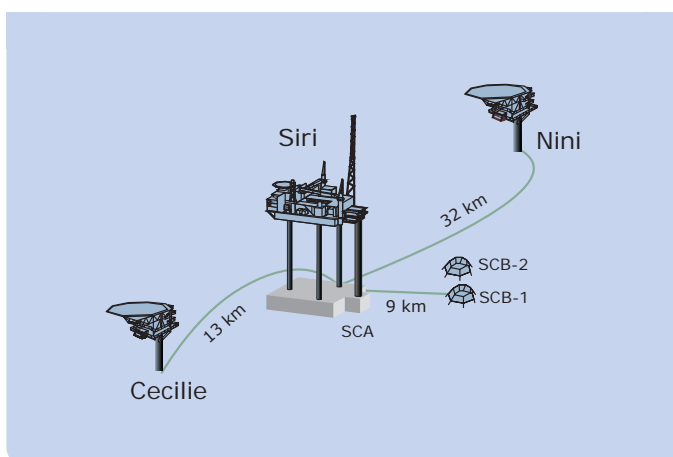
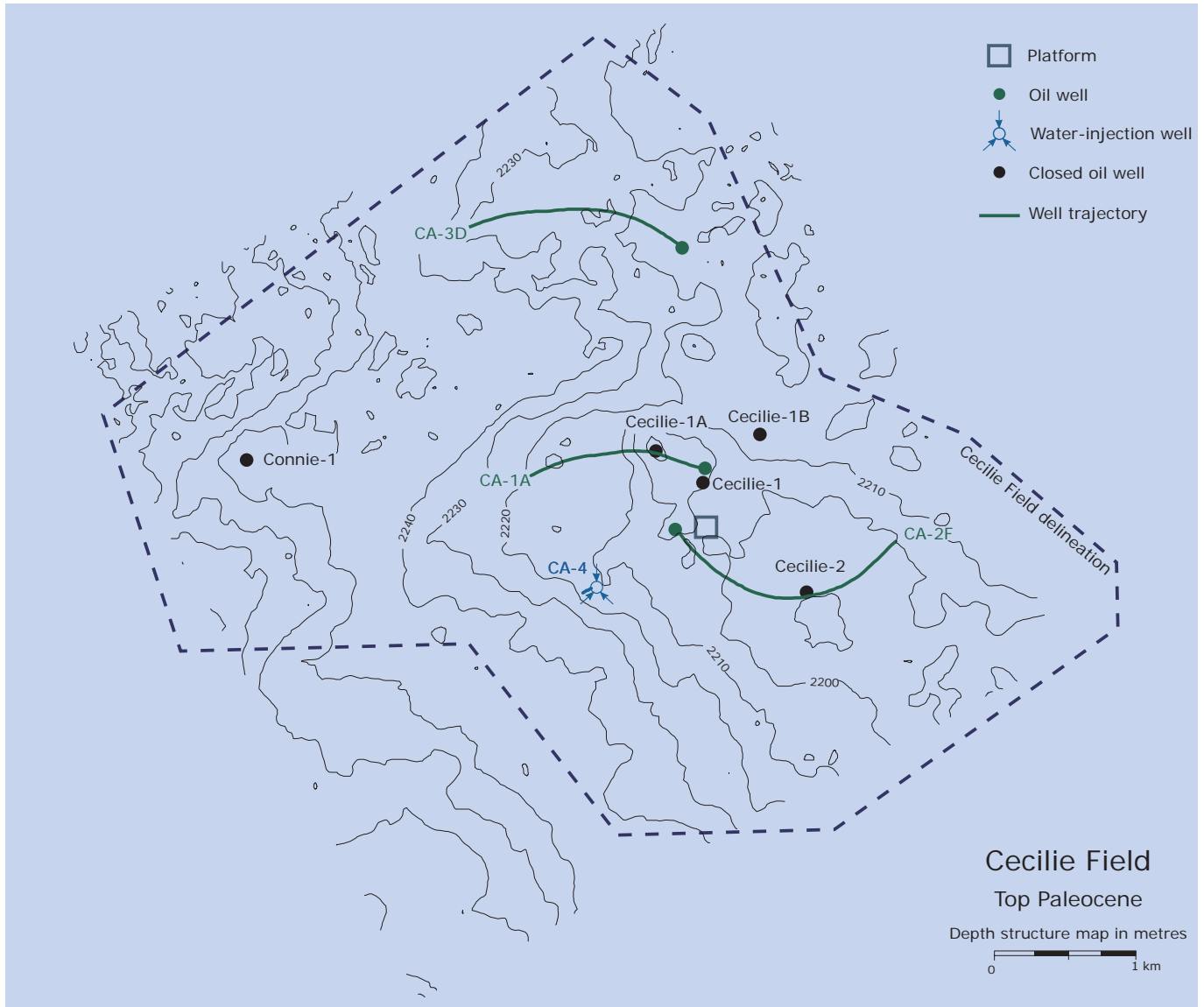
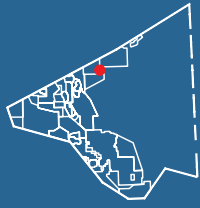
The wells are divided into production wells and injection wells. The chart shows the primary function of the wells in the relevant year, either production or injection. A well may be used for production for part of a year and then be converted to injection for the rest of the year.

■ Injection wells ■ Production wells ■ Prod/Inject wells\*

\*Only relevant for the Tyra Field. A few wells alternate between injection and production.

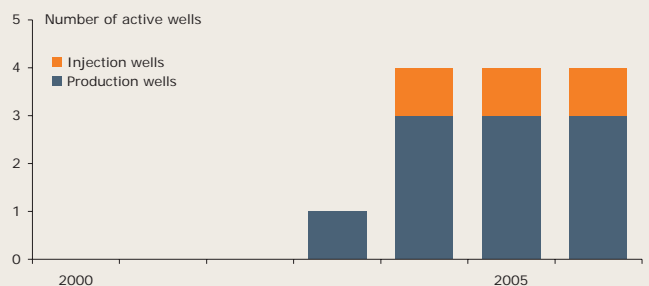
## APPENDIX B: PRODUCING FIELDS

### THE CECILIE FIELD



### DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 1.2 billion





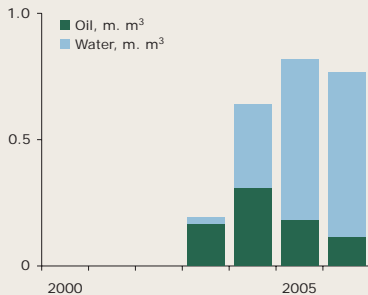
## FIELD DATA at 1 January 2007

Location:	Blocks 5604/19 and 20
Licence:	16/98
Operator:	DONG E&P A/S
Discovered:	2000
Year on stream:	2003
Producing wells:	3
Water-injection wells:	1
Water depth:	60 m
Field delineation:	22.6 km <sup>2</sup>
Reservoir depth:	2,200 m
Reservoir rock:	Sandstone
Geological age:	Paleocene

## PRODUCTION

Cum. production at 1 January 2007

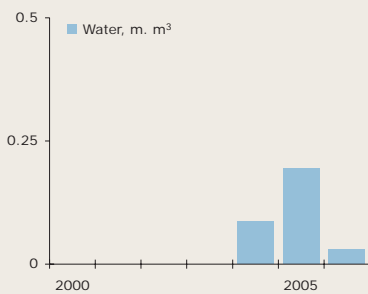
Oil:	0.77 m. m <sup>3</sup>
Gas:	0.06 bn. Nm <sup>3</sup>
Water:	1.64 m. m <sup>3</sup>



## INJECTION

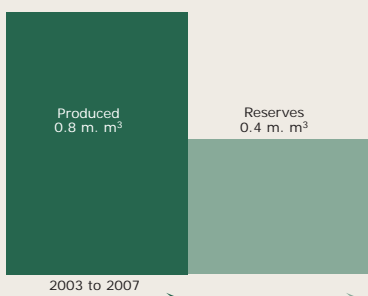
Cum. injection at 1 January 2007

Water:	0.31 m. m <sup>3</sup>
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## RESERVES

Oil:	0.4 m. m <sup>3</sup>
Gas:	0.0 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Cecilie accumulation is a combined structural and stratigraphic trap. It is an anti-clinal structure induced through salt tectonics, delimited by faults and redeposited sands. The Cecilie Field also comprises the Connie accumulation.

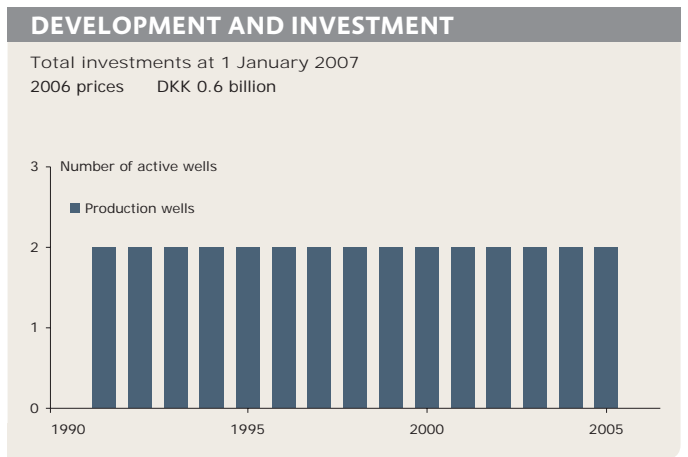
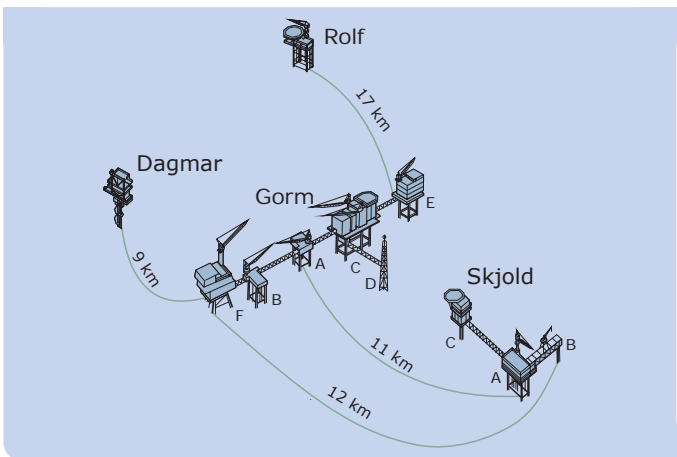
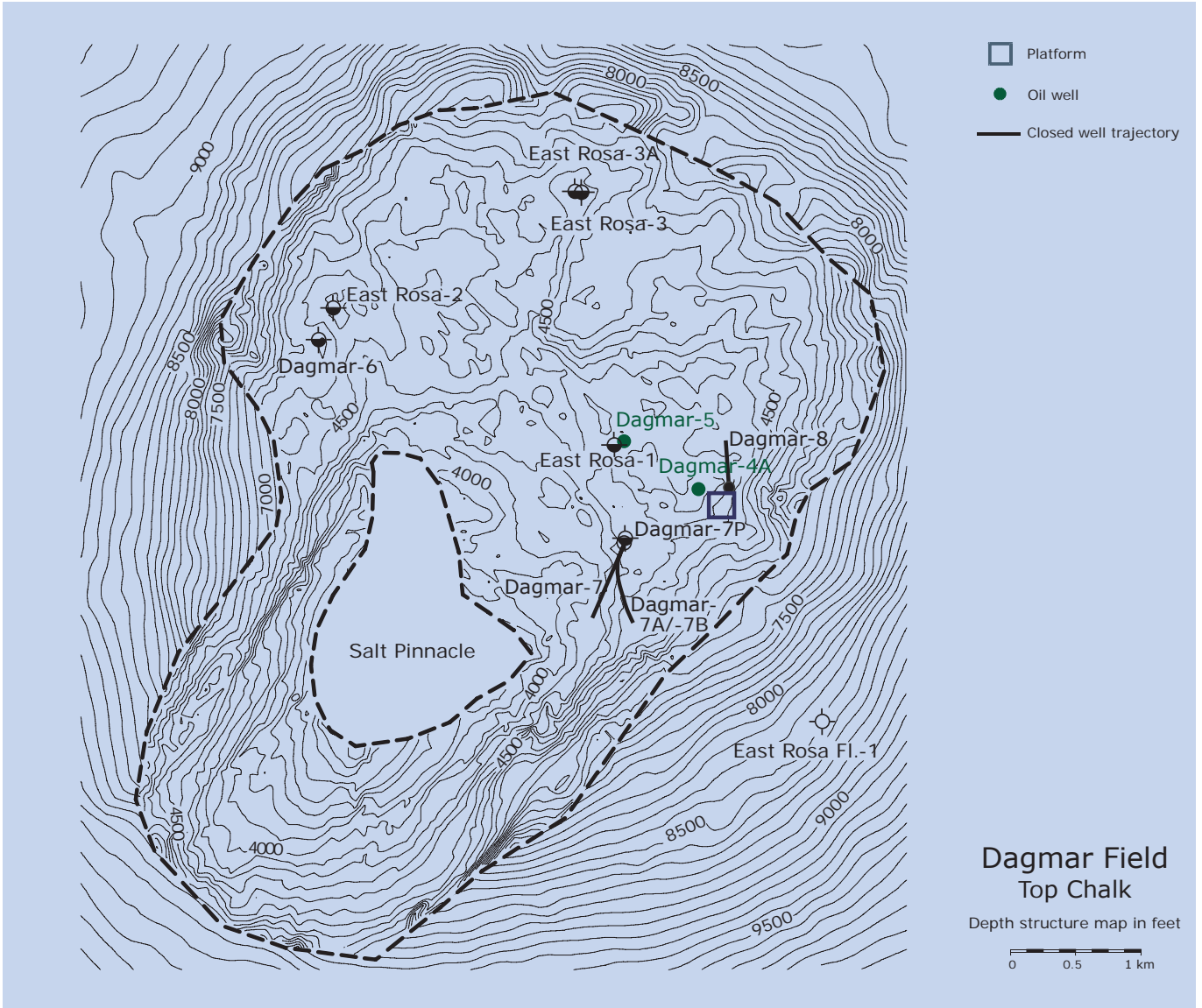
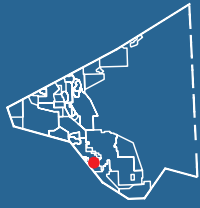
## PRODUCTION STRATEGY

Recovery is based on water injection to maintain reservoir pressure. The production wells have been drilled in the crest of the structure, while water is injected in the flank of the field.

## PRODUCTION FACILITIES

The Cecilie Field is a satellite development to the Siri Field with one unmanned well-head platform with a helideck. The unprocessed production is transported to the Siri platform through a 12" multiphase pipeline. The oil is processed at the Siri platform and exported to shore via tanker. The gas produced is injected into the Siri Field. Injection water is transported to the Cecilie Field through a 10" pipeline.

# THE DAGMAR FIELD

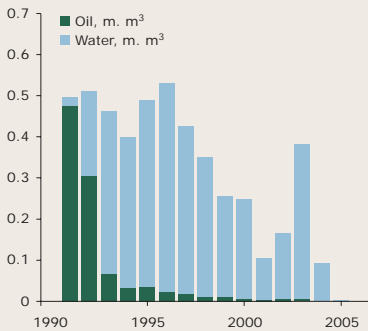


## FIELD DATA at 1 January 2007

Prospect:	East Rosa
Location:	Block 5504/15
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1983
Year on stream:	1991
Producing wells:	2
Water depth:	34 m
Area:	9 km <sup>2</sup>
Reservoir depth:	1,400 m
Reservoir rock:	Chalk and Carbonates
Geological age:	Danian, Upper Cretaceous and Zechstein

## PRODUCTION

Cum. production at 1 January 2007	
Oil:	1.01 m. m <sup>3</sup>
Gas:	0.16 bn. Nm <sup>3</sup>
Water:	3.91 m. m <sup>3</sup>



## RESERVES

Oil:	0.0 m. m <sup>3</sup>
Gas:	0.0 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Dagmar Field is an anticlinal structure, induced through salt tectonics. The uplift is very pronounced, and the Dagmar oil reservoir is situated closer to the surface than any other hydrocarbon reservoirs in Danish territory. The reservoir is heavily fractured (compare Skjold, Rolf, Regnar and Svend). However, the water zone does not appear to be particularly fractured.

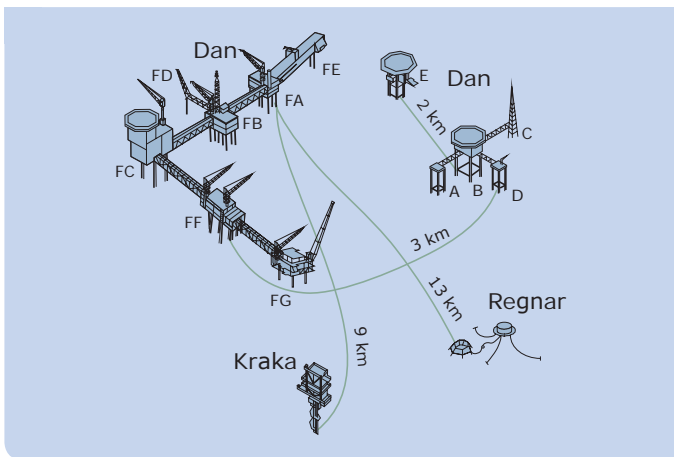
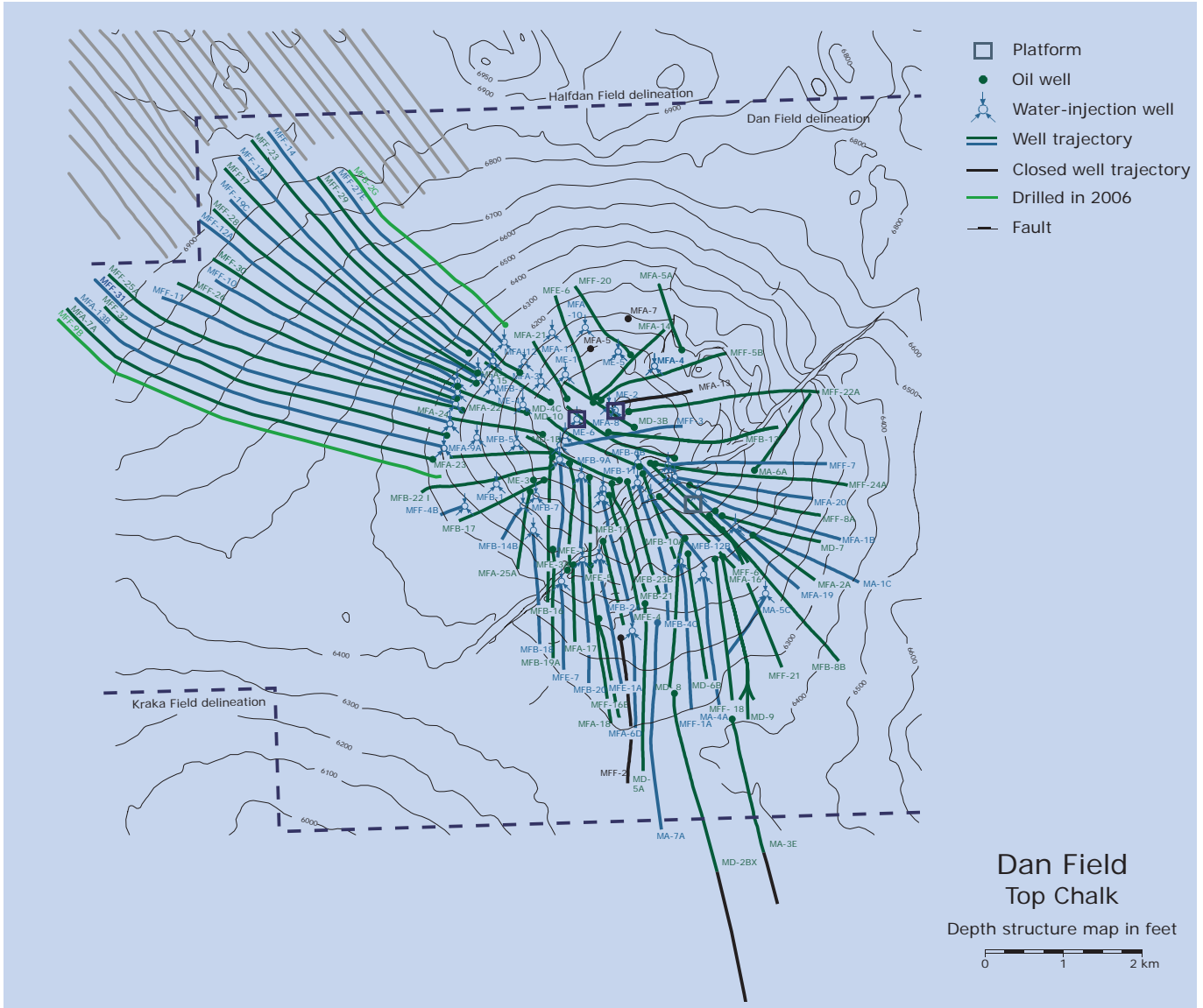
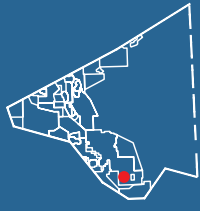
## PRODUCTION STRATEGY

The recovery strategy for the Dagmar Field is based on achieving the highest possible production rate from the wells. Initially, the oil production rates were high in the Dagmar Field, but it has not been possible to sustain the good production performance characterizing the Skjold, Svend and Rolf Fields. In 2006, the two production wells were closed in.

## PRODUCTION FACILITIES

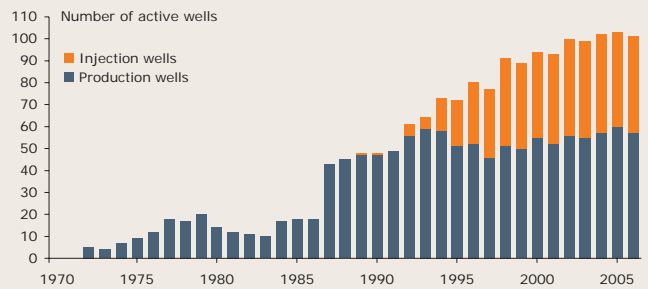
The Dagmar Field is a satellite development to the Gorm Field with one unmanned wellhead platform without a helideck. The unprocessed production is transported to the Gorm F platform, where separate facilities for handling the sour gas from the Dagmar Field have been installed. The small amount of gas produced from Dagmar is flared due to its high content of hydrogen sulphide.

# THE DAN FIELD



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 25.9 billion



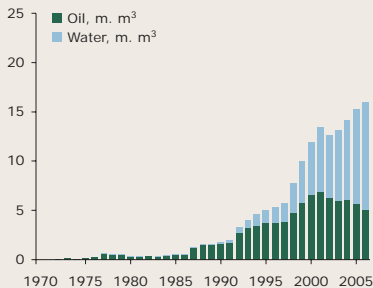
## FIELD DATA at 1 January 2007

Prospect:	Abby
Location:	Block 5505/17
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1971
Year on stream:	1972
Producing wells:	56
Water-injection wells:	50
Water depth:	40 m
Field delineation:	121 km <sup>2</sup>
Reservoir depth:	1,850 m
Reservoir rock:	Chalk
Geological age:	Danian and Upper Cretaceous

## PRODUCTION

Cum. production at 1 January 2007

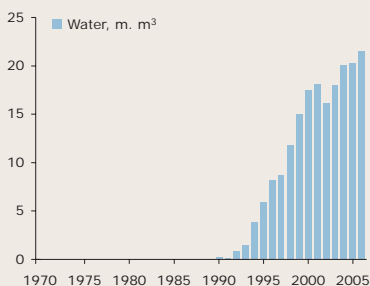
Oil:	86.35 m. m <sup>3</sup>
Gas:	21.08 bn. Nm <sup>3</sup>
Water:	69.19 m. m <sup>3</sup>



## INJECTION

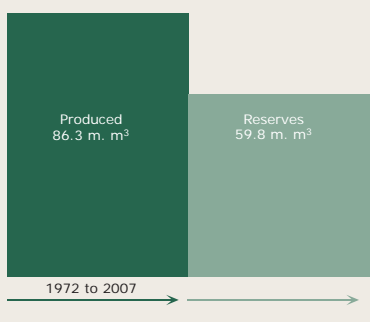
Cum. injection at 1 January 2007

Water:	187.88 m. m <sup>3</sup>
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## RESERVES

Oil:	59.8 m. m <sup>3</sup>
Gas:	6.3 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Dan Field is an anticlinal structure induced partly due to salt tectonics. A major fault divides the field into two reservoir blocks, which, in turn, are intersected by a number of minor faults. The chalk reservoir has high porosity, although low permeability. There is a gas cap in the field.

Recovery takes place from the central part of the Dan Field and from large sections of the flanks of the field. Particularly the western flank of the Dan Field, close to the Halfdan Field, has demonstrated good production properties.

## PRODUCTION STRATEGY

Recovery from the field is based on the simultaneous production of oil and injection of water. Water injection was initiated in 1989, and later water injection was introduced in large sections of the field. The recovery of oil is optimized by flooding the reservoir with water to the extent possible.

## PRODUCTION FACILITIES

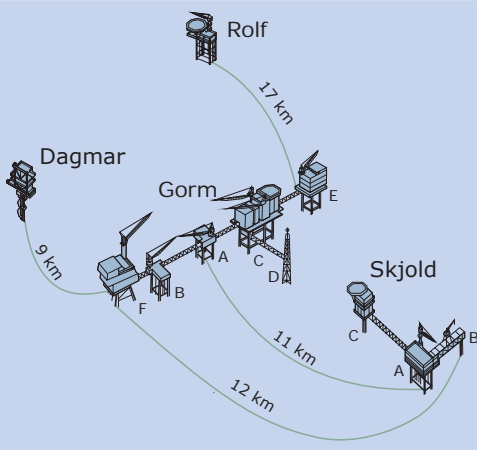
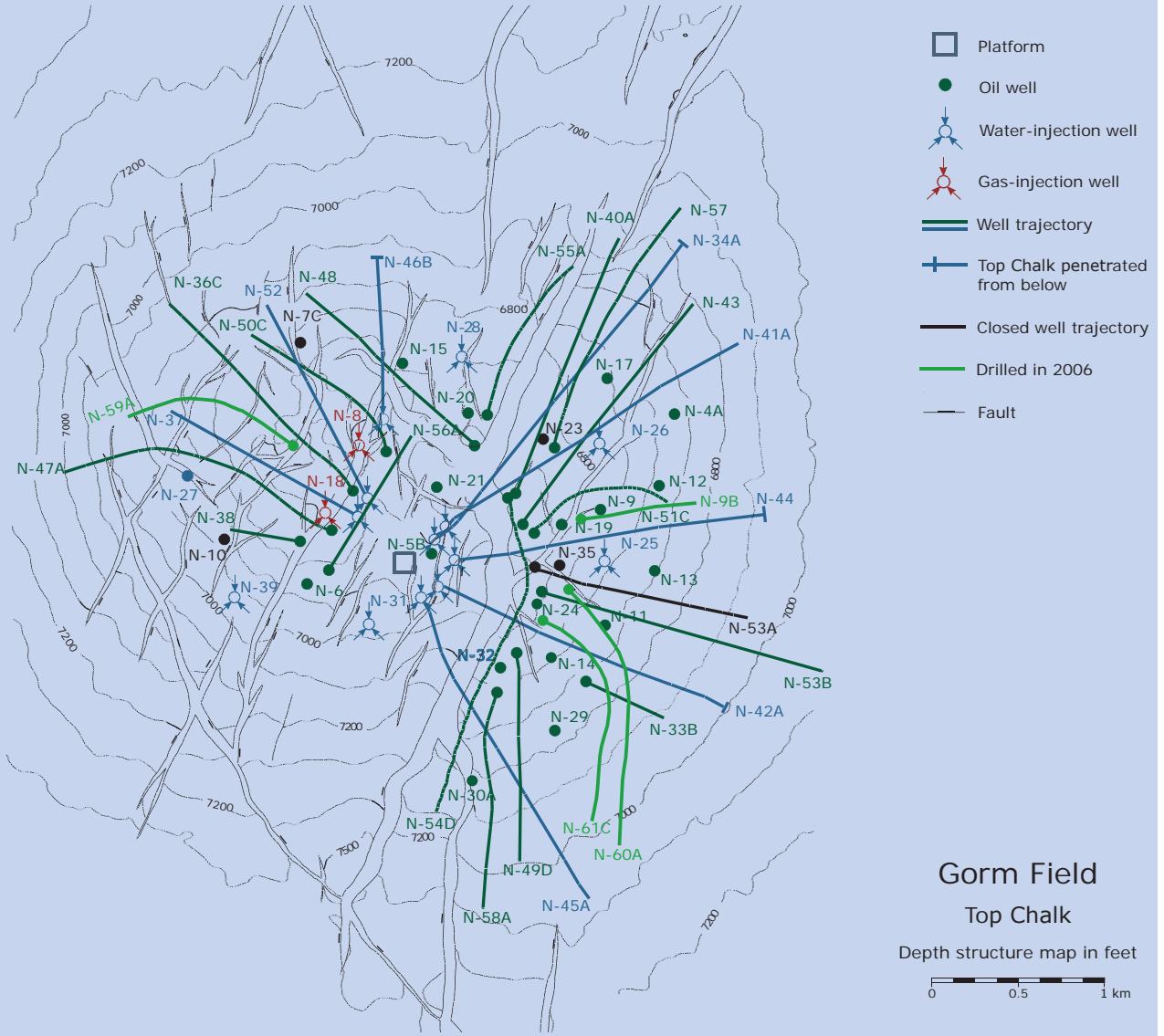
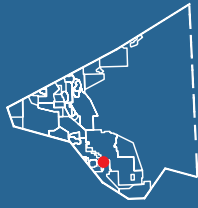
The Dan Field comprises six wellhead platforms, A, D, E, FA, FB and FE, a combined wellhead and processing platform, FF, a processing platform with a flare tower, FG, two processing and accommodation platforms, B and FC, and two gas flare stacks, C and FD.

At the Dan Field, there are facilities for receiving production from the adjacent Kraka and Regnar satellite fields, as well as for receiving gas produced at the Halfdan Field. The Dan installations supply the Halfdan Field with injection water.

After final processing, the oil is transported to shore via the riser platform, Gorm E. The gas is pre-processed and transported to Tyra East for final processing. Treated production water from Dan and its satellite fields is discharged into the sea.

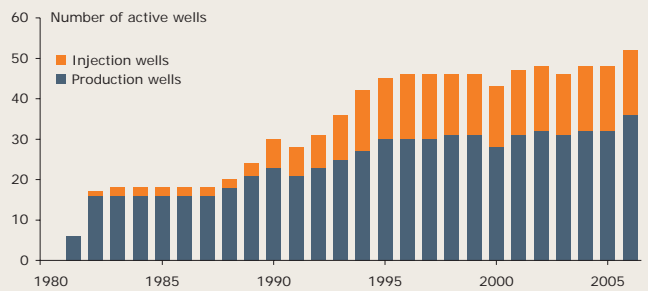
The Dan Field has accommodation facilities for 97 persons on the FC platform. The B platform has accommodation facilities for five persons.

# THE GORM FIELD



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 12.4 billion

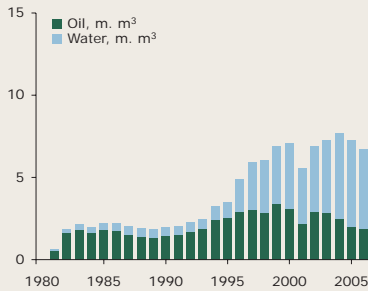


## FIELD DATA at 1 January 2007

Prospect:	Vern
Location:	Blocks 5504/15 and 16
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1971
Year on stream:	1981
Producing wells:	36
Gas-injection wells:	2
Water-injection wells:	14
Water depth:	39 m
Field delineation:	33 km <sup>2</sup>
Reservoir depth:	2,100 m
Reservoir rock:	Chalk
Geological age:	Danian and Upper Cretaceous

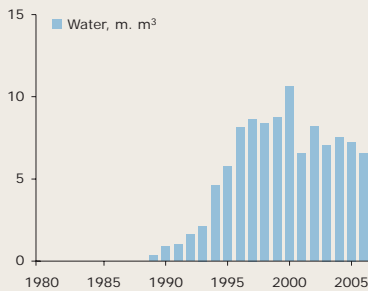
## PRODUCTION

Cum. production at 1 January 2007	
Oil:	54.40 m. m <sup>3</sup>
Gas:	15.06 bn. Nm <sup>3</sup>
Water:	49.81 m. m <sup>3</sup>



## INJECTION

Cum. injection at 1 January 2007	
Gas:	8.16 bn. Nm <sup>3</sup>
Water:	104.0 m. m <sup>3</sup>



## RESERVES

Oil:	12.4 m. m <sup>3</sup>
Gas:	1.1 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Gorm Field is an anticlinal structure induced partly due to salt tectonics. A major fault extending north-south divides the field into two reservoir blocks. The western reservoir block is intersected by numerous, minor faults.

## PRODUCTION STRATEGY

The production strategy for the Gorm Field is to maintain reservoir pressure through water injection, which was initiated in 1989. In addition, the influx of water from the aquifer and compaction in the reservoir stimulate production. Water injection takes place both at the flank of the field and from the bottom of the reservoir.

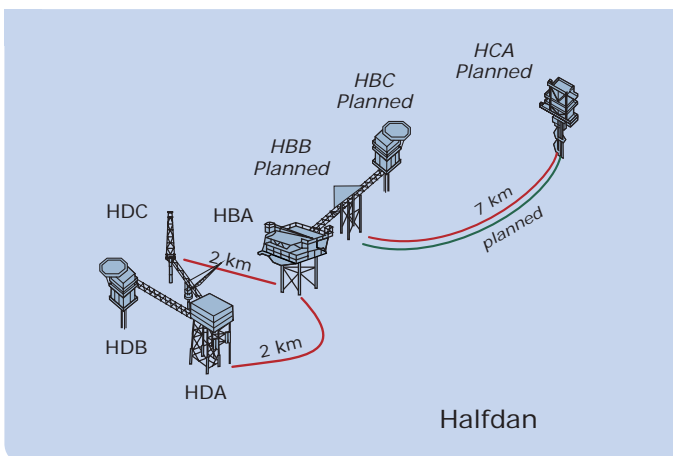
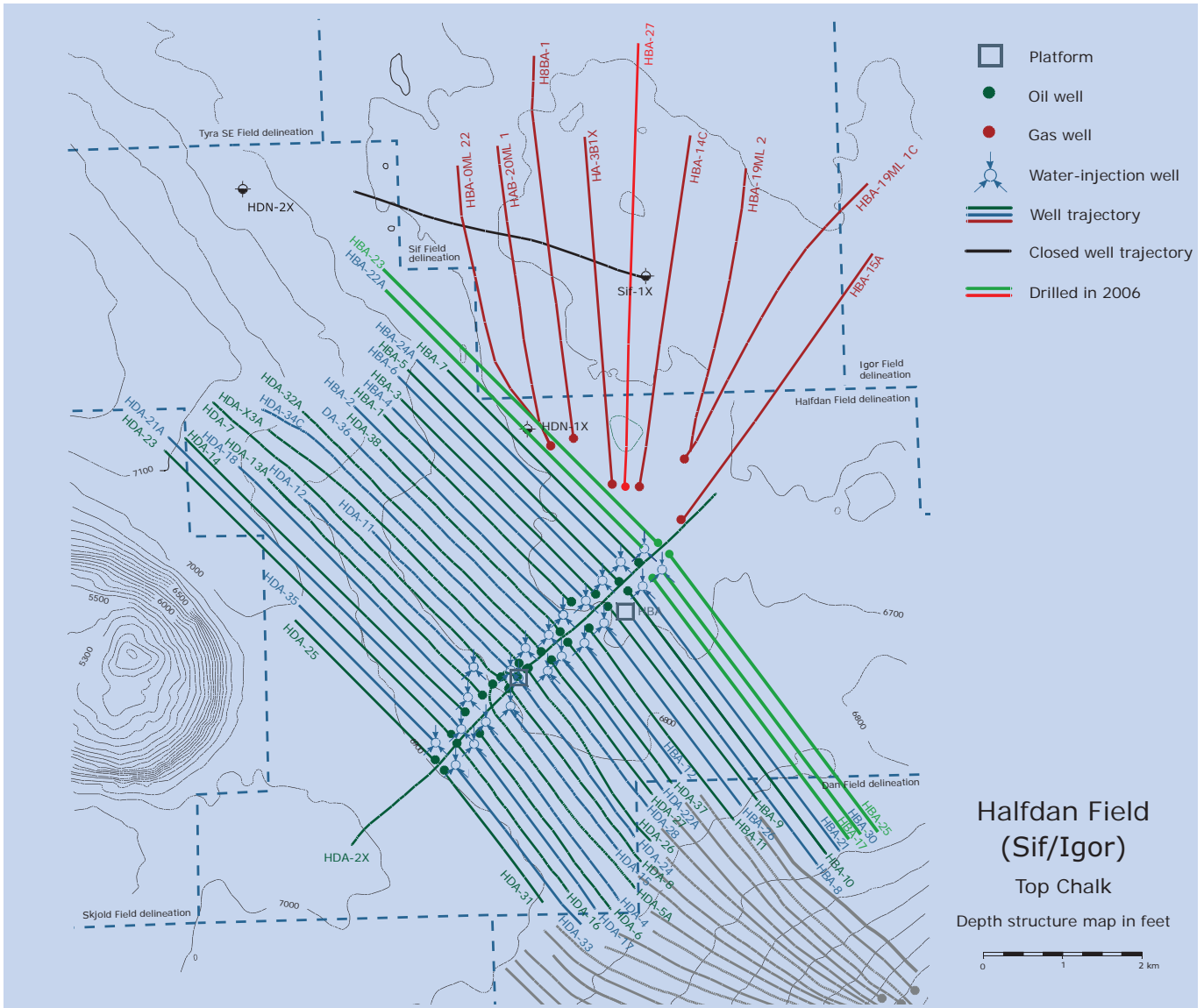
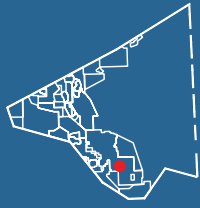
## PRODUCTION FACILITIES

The Gorm Field consists of two wellhead platforms, Gorm A and B, one processing and accommodation platform, Gorm C, one gas flare stack, Gorm D, one riser platform, Gorm E (owned by DONG Oil Pipe A/S) and one combined wellhead, processing and riser platform, Gorm F.

Gorm receives production from the satellite fields, Skjold, Rolf and Dagmar. The Gorm Field installations supply the Skjold Field with injection water and lift gas and the Rolf Field with lift gas. The stabilized oil from all DUC's facilities is transported ashore via the riser platform Gorm E. The gas produced is sent to Tyra East. The oil produced at the Halfdan Field is transported to Gorm C for final processing.

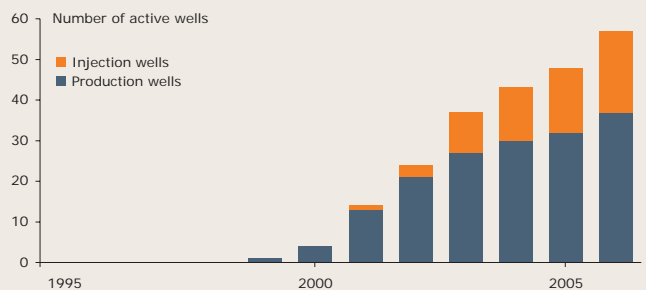
There are accommodation facilities on the Gorm C platform for 98 persons.

# THE HALFDAN FIELD, INCL. SIF AND IGOR



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 10.5 billion





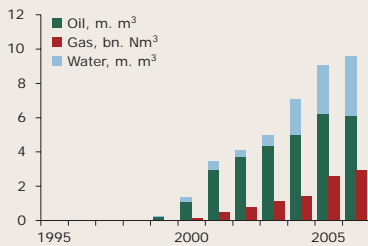
## FIELD DATA at 1 January 2007

Prospect:	Nana (Halfdan)
Location:	Blocks 5505/13 and 5504/16
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1999 (Halfdan and Sif) 1968 (Igor)
Year on stream:	1999 (Halfdan) 2004 (Sif and Igor)
Oil-prod. wells:	27 (Halfdan)
Water-inj. wells:	23 (Halfdan)
Gas-prod. wells:	7 (Sif)
Water depth:	43 m
Field delineation:	107 km <sup>2</sup> (Halfdan) 109 km <sup>2</sup> (Igor) 40 km <sup>2</sup> (Sif)
Reservoir depth:	2,050-2,100 m
Reservoir rock:	Chalk
Geological age:	Danian and Upper Cretaceous

## PRODUCTION

Cum. production at 1 January 2007

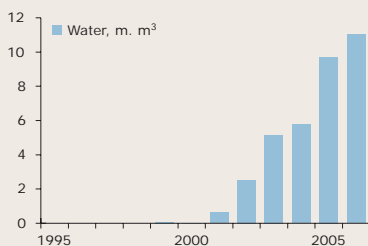
Oil:	29.61 m. m <sup>3</sup>
Gas:	9.62 bn. Nm <sup>3</sup>
Water:	10.15 m. m <sup>3</sup>



## INJECTION

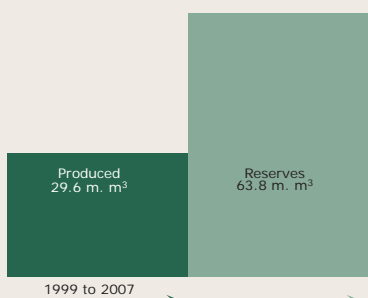
Cum. injection at 1 January 2007

Water:	34.91 m. m <sup>3</sup>
--------	-------------------------



## RESERVES

Oil:	63.8 m. m <sup>3</sup>
Gas:	23.1 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Halfdan Field comprises the Halfdan, Sif and Igor areas and contains a large continuous hydrocarbon accumulation at different strata levels. The southwestern part of the field primarily contains oil in Maastrichtian layers, while the area towards the north and east primarily contains gas in Danian layers.

The accumulation is contained in a limited part of the chalk formation, which constituted a structural trap in earlier geological times. The structure gradually disintegrated, and the oil began migrating away from the area due to later movements in the reservoir layers. However, the oil and gas deposits have migrated a short distance only due to the low permeability of the reservoir. This porous, unfractured chalk is similar to that found in the western flank of the Dan Field.

## PRODUCTION STRATEGY

Recovery is based on the Fracture Aligned Sweep Technology (FAST), where long horizontal wells are arranged in a pattern of alternate production and injection wells with parallel well trajectories. Varying the injection pressure in the well causes the rock to fracture. This generates a continuous water front along the whole length of the well, which drives the oil in the direction of the production wells. The production of gas from Danian layers is based on primary recovery, using the reservoir pressure.

## PRODUCTION FACILITIES

The Halfdan Field comprises a combined wellhead and processing platform, HDA, one accommodation platform, HDB, one gas flare stack, HDC, and an unmanned satellite wellhead platform, HBA, without a helideck. The HBA satellite platform is located about 2 km from the other Halfdan platforms, which provide it with power, injection water and lift gas.

After separation at the HDA platform, production from the oil wells is transported to the Gorm Field for processing.

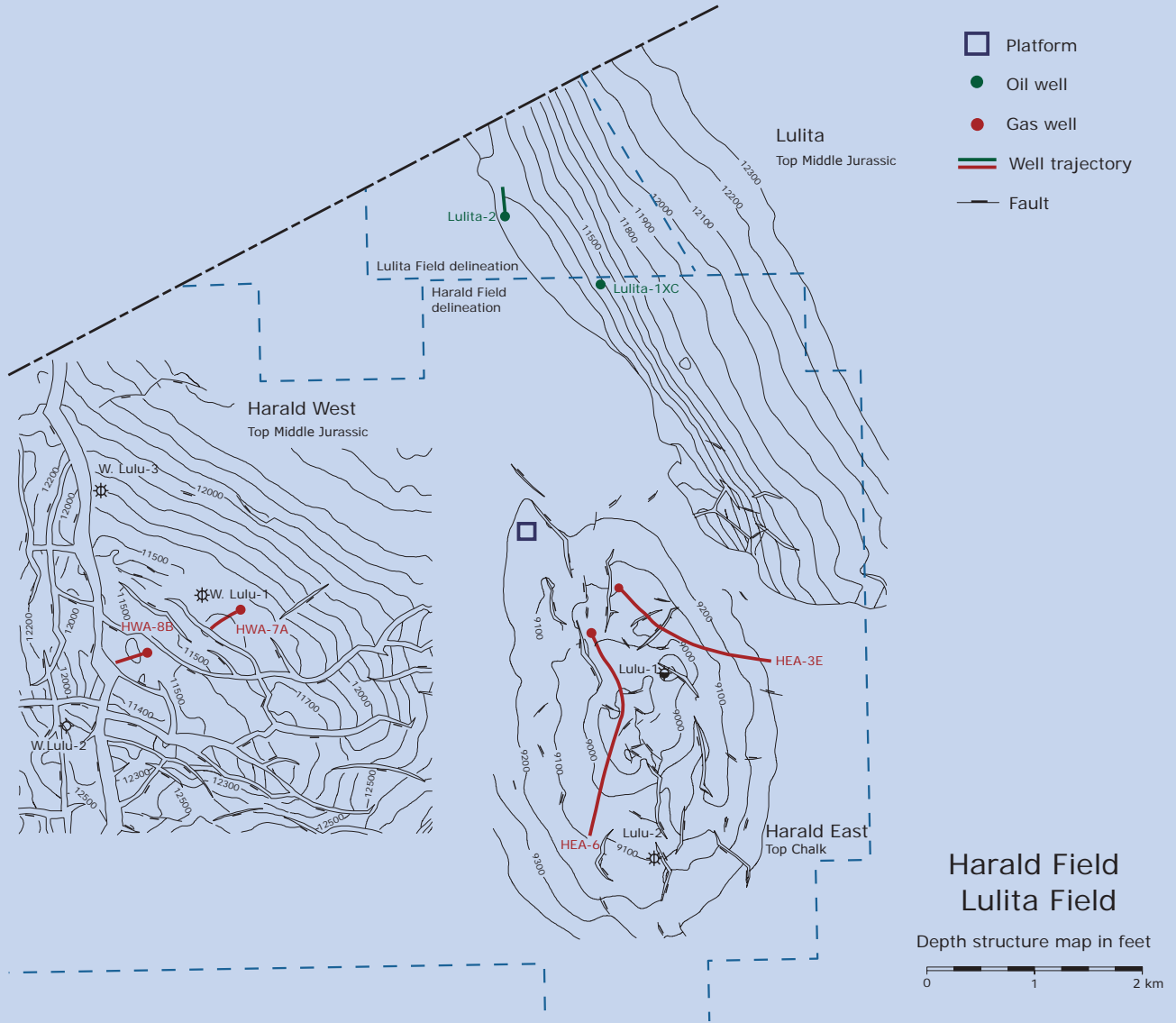
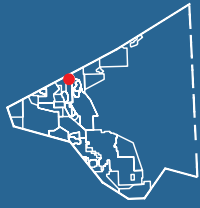
The gas produced by the wells in the Sif area is transported from the HBA platform to Tyra West, while the gas from Halfdan HDA is transported to Dan for export ashore or to Tyra West for export through the NOGAT pipeline.

The Dan installations supply the Halfdan Field with injection water. Treated production water from Halfdan is discharged into the sea.

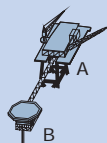
The Halfdan HDB platform has accommodation facilities for 32 persons.

The Halfdan Field installations are being extended by a further three platforms.

# THE HARALD FIELD

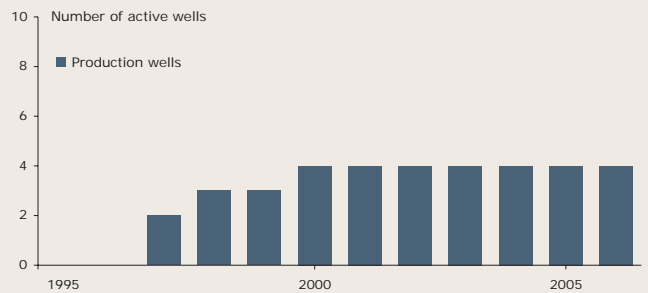


Harald / Lulita



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 3.6 billion



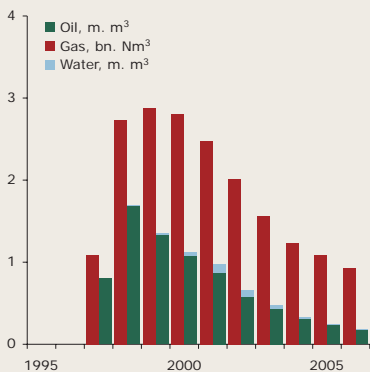
## FIELD DATA at 1 January 2007

Prospect:	Lulu/West Lulu
Location:	Blocks 5604/21 and 22
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1980 (Lulu) 1983 (West Lulu)
Year on stream:	1997
Gas-producing wells:	2 (Harald East), 2 (Harald West)
Water depth:	64 m
Field delineation:	56 km <sup>2</sup>
Reservoir depth:	2,700 and 3,650 m, respectively
Reservoir rock:	Chalk (Harald East) Sandstone (Harald West)
Geological age:	Danian, Upper Cretaceous and Middle Jurassic

## PRODUCTION

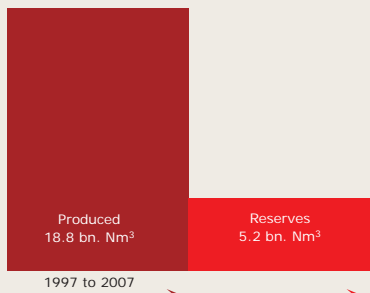
Cum. production at 1 January 2007

Oil and condensate:	7.49 m. m <sup>3</sup>
Gas:	18.83 bn. Nm <sup>3</sup>
Water:	0.32 m. m <sup>3</sup>



## RESERVES

Oil and condensate:	1.0 m. m <sup>3</sup>
Gas:	5.2 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Harald Field consists of two accumulations, Lulu (Harald East) and West Lulu (Harald West), which contain gas mainly.

The Harald East structure is an anticline induced through salt tectonics. The gas zone is up to 75 metres thick.

The Harald West structure is a tilted Jurassic fault block. The sandstone reservoir is of Middle Jurassic age, and is 100 metres thick.

## PRODUCTION STRATEGY

Recovery from both the Harald East and the Harald West reservoir takes place by gas expansion, supplemented by a moderate, natural influx of water into the reservoir.

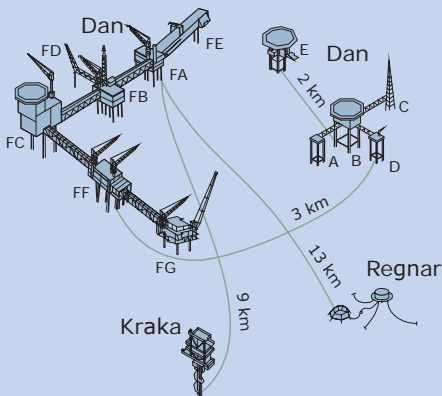
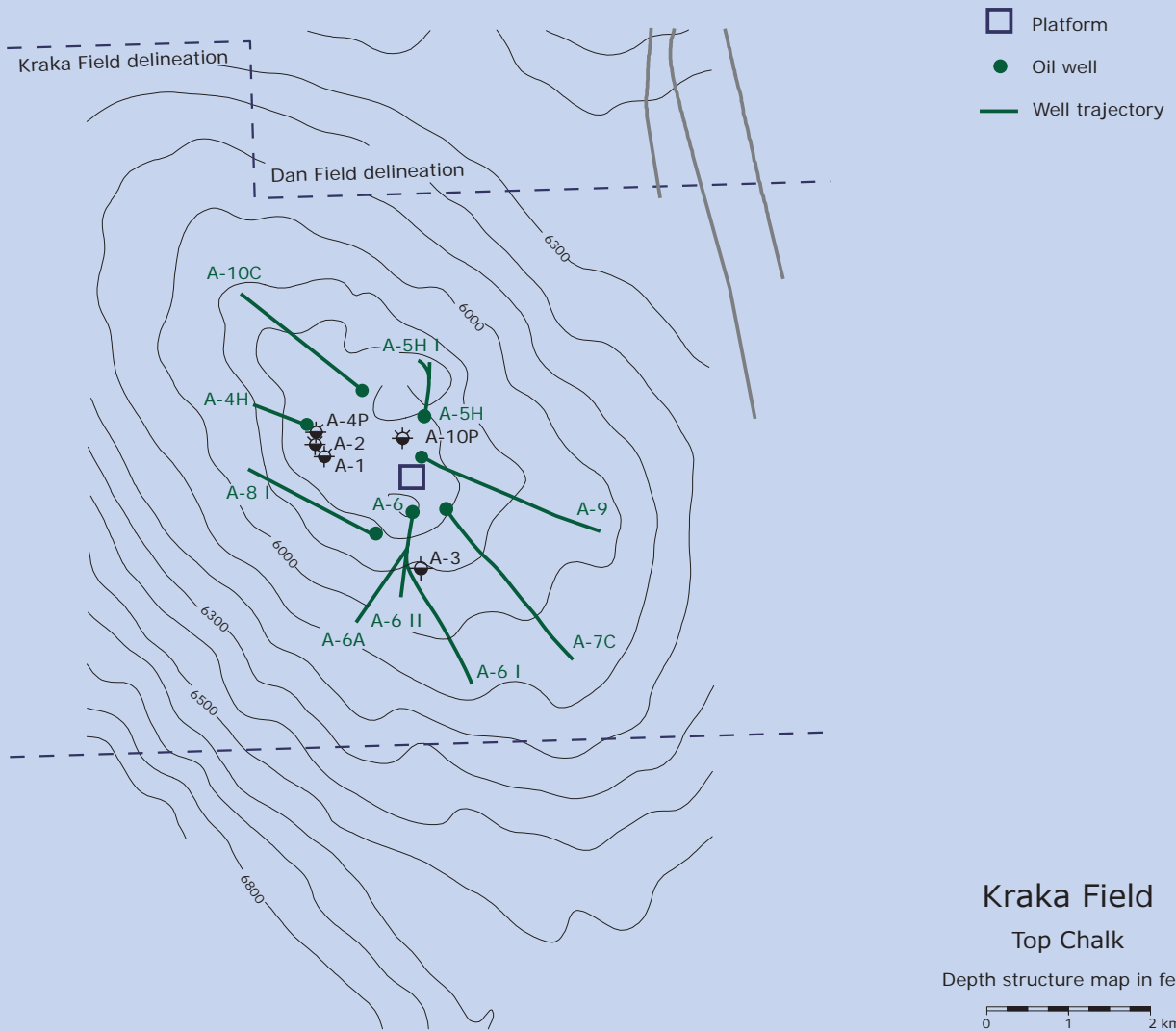
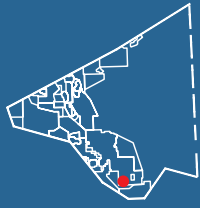
Production from the Harald Field is based on the aim of optimizing the production of liquid hydrocarbons in the Tyra Field. By maximizing the drainage from the other gas fields, the drainage from Tyra is minimized.

## PRODUCTION FACILITIES

The Harald Field comprises a combined wellhead and processing platform, Harald A, and an accommodation platform, Harald B. The unprocessed condensate and the processed gas are transported to Tyra East. Treated production water is discharged into the sea.

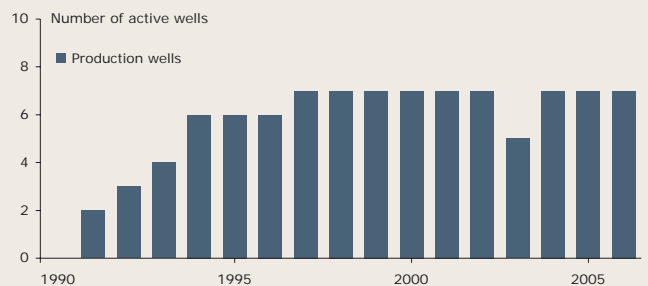
The Harald Field is hooked up to the gas pipeline that transports gas from the South Arne Field to Nybro. Normally, no gas is exported from Harald through the pipeline. The Harald Field has accommodation facilities for 16 persons.

# THE KRAKA FIELD



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 1.5 billion



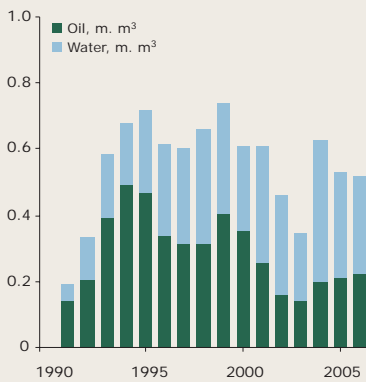
## FIELD DATA at 1 January 2007

Prospect:	Anne
Location:	Block 5505/17
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1966
Year on stream:	1991
Producing wells:	7
Water depth:	45 m
Field delineation:	81 km <sup>2</sup>
Reservoir depth:	1,800 m
Reservoir rock:	Chalk
Geological age:	Danian and Upper Cretaceous

## PRODUCTION

Cum. production at 1 January 2007

Oil:	4.60 m. m <sup>3</sup>
Gas:	1.32 bn. Nm <sup>3</sup>
Water:	4.21 m. m <sup>3</sup>



## RESERVES

Oil:	2.8 m. m <sup>3</sup>
Gas:	0.7 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

Kraka is an anticlinal structure induced through salt tectonics, which has caused some fracturing in the chalk. The reservoir has reasonable porosity, although low permeability. The thin oil pay zone is further characterized by high water saturations. There is a minor gas cap in the reservoir.

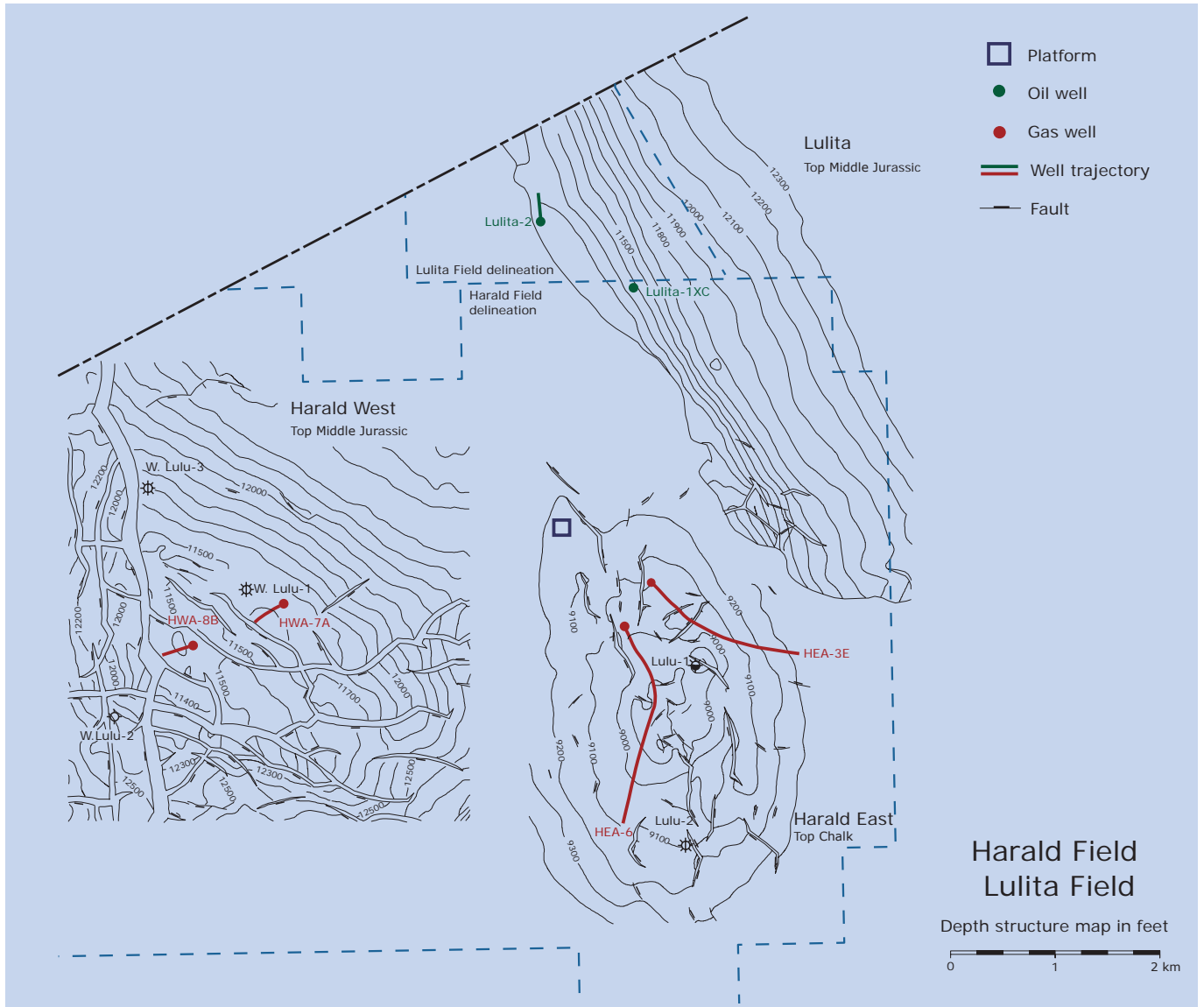
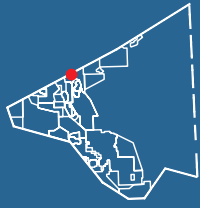
## PRODUCTION STRATEGY

Recovery from Kraka is based on the natural expansion of the gas cap and aquifer support. The individual wells are produced at the lowest possible bottom-hole pressure. Oil production from the field is maximized by prioritizing gas lift in wells with a low water content and a low gas-oil ratio.

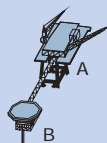
## PRODUCTION FACILITIES

Kraka is a satellite development to the Dan Field with one unmanned wellhead platform without a helideck. The production is transported to Dan F for processing and export ashore. Lift gas is imported from the Dan Field.

# THE LULITA FIELD

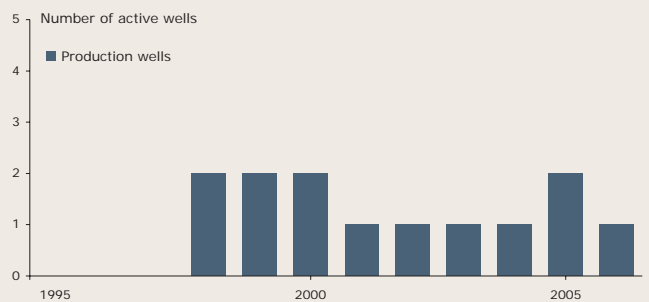


Harald / Lulita



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 0.1 billion



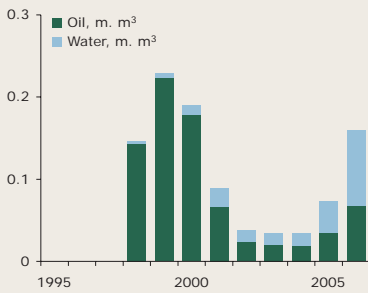
## FIELD DATA at 1 January 2007

Location:	Blocks 5604/18 and 22
Licence:	Sole Concession (50 %), 7/86 (34.5 %) and 1/90 (15.5 %)
Operator:	Mærsk Olie og Gas AS
Discovered:	1992
Year on stream:	1998
Producing wells:	2
Water depth:	65 m
Area:	3 km <sup>2</sup>
Reservoir depth:	3,525 m
Reservoir rock:	Sandstone
Geological age:	Middle Jurassic

## PRODUCTION

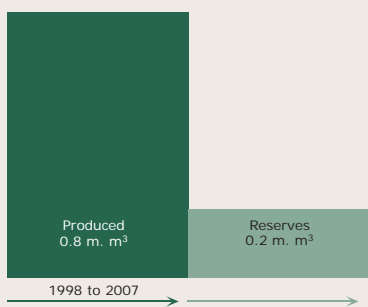
Cum. production at 1 January 2007

Oil:	0.78 m. m <sup>3</sup>
Gas:	0.50 bn. Nm <sup>3</sup>
Water:	0.21 m. m <sup>3</sup>



## RESERVES

Oil:	0.2 m. m <sup>3</sup>
Gas:	0.6 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Lulita Field is a structural fault trap with a Middle Jurassic sandstone reservoir. The accumulation consists of oil with a gas cap.

## PRODUCTION STRATEGY

The production of oil and gas is based on natural depletion.

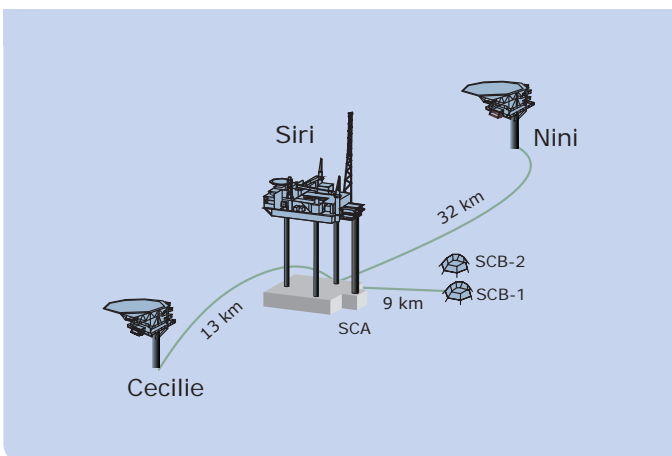
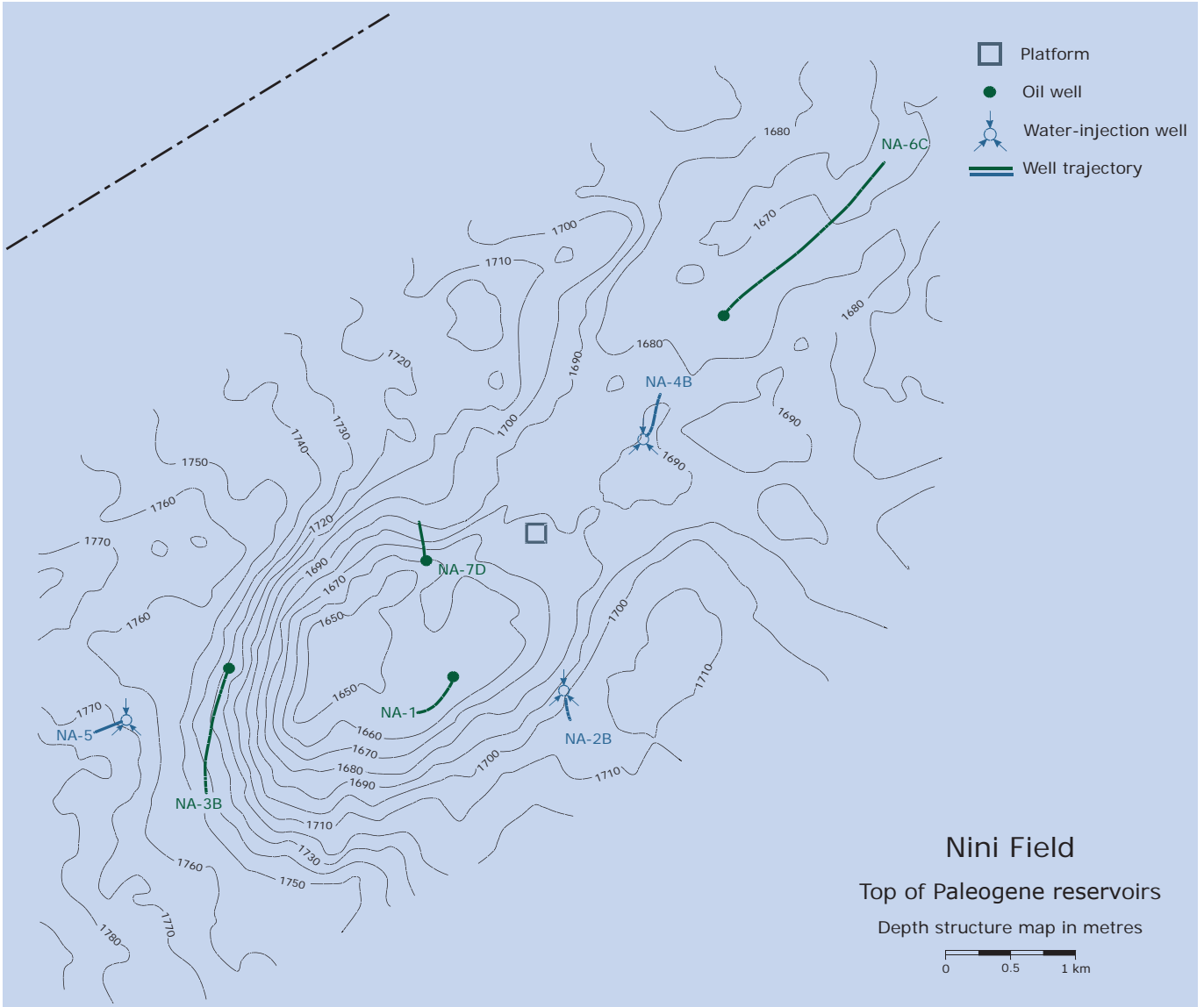
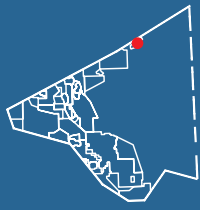
## PRODUCTION FACILITIES

Production from the Lulita Field takes place from the fixed installations in the Harald Field. Thus, the Lulita facilities are hosted by the Harald A platform, and the Harald platform processing equipment also handles production from the Lulita Field.

Together with condensate from the Harald Field, the oil produced is transported through a 16" pipeline to Tyra East for export ashore. The gas produced in the Lulita Field is transported to Tyra through the 24" pipeline connecting Harald with Tyra East, from where it is transported to shore. The water produced at the Lulita Field is processed at the Harald Field facilities and subsequently discharged into the sea.

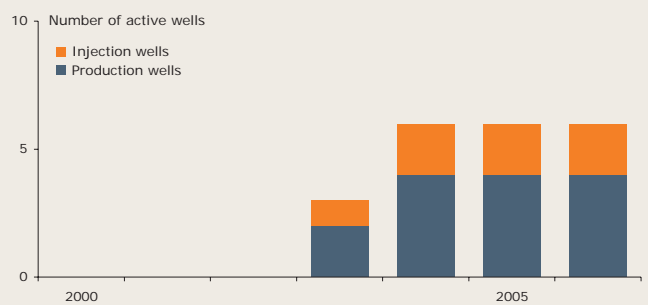
The Harald A platform has special equipment for separate metering of the oil and gas produced from the Lulita Field.

# THE NINI FIELD



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 2.1 billion



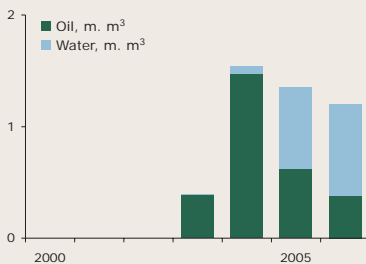


## FIELD DATA at 1 January 2007

Location:	Blocks 5605/10 and 14
Licence:	4/95
Operator:	DONG E&P A/S
Discovered:	2000
Year on stream:	2003
Producing wells:	4
Water-injection wells:	3
Water depth:	60 m
Field delineation:	48.8 km <sup>2</sup>
Reservoir depth:	1,700 m
Reservoir rock:	Sandstone
Geological age:	Paleogene

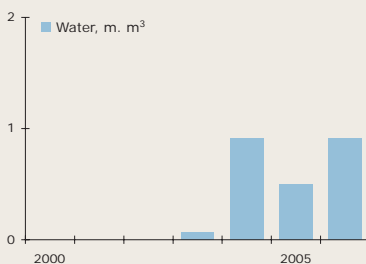
## PRODUCTION

Cum. production at 1 January 2007	
Oil:	2.87 m. m <sup>3</sup>
Gas:	0.22 bn. Nm <sup>3</sup>
Water:	1.62 m. m <sup>3</sup>



## INJECTION

Cum. injection at 1 January 2007	
Water:	2.4 m. m <sup>3</sup>



## RESERVES

Oil:	1.0 m. m <sup>3</sup>
Gas:	0.0 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Nini accumulation is defined by a combined structural and stratigraphic trap, the anticlinal structure being induced through salt tectonics. The reservoir consists of sands deposited in the Siri Fairway. The Nini Field also includes the Nini West area.

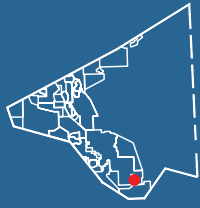
## PRODUCTION STRATEGY

The production strategy is to maintain reservoir pressure by means of water injection. The gas produced is injected into the Siri Field.

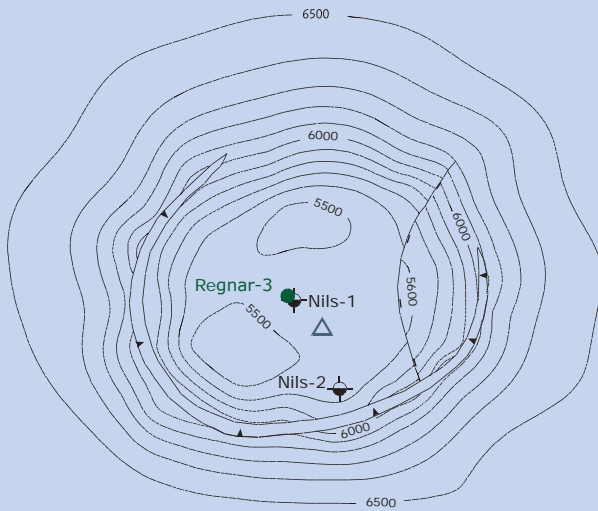
## PRODUCTION FACILITIES

The Nini Field is a satellite development to the Siri Field with one unmanned well-head platform with a helideck. The unprocessed production is transported through a 14" multiphase pipeline to the Siri platform where it is processed and exported to shore via tanker. Injection water and lift gas are transported from the Siri platform to the Nini platform through a 10" pipeline and a 4" pipeline, respectively.

# THE REGNAR FIELD

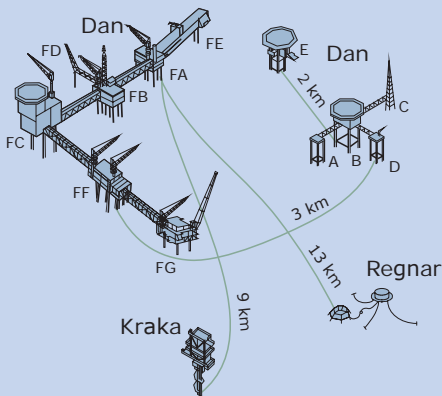
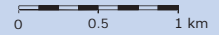


- △ Subsea installation
- Oil well
- Fault



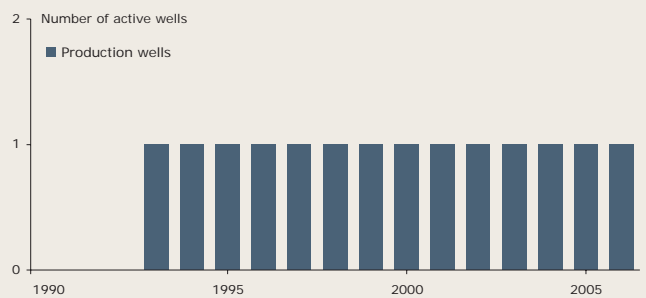
## Regnar Field Top Chalk

Depth structure map in feet



### DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 0.2 billion

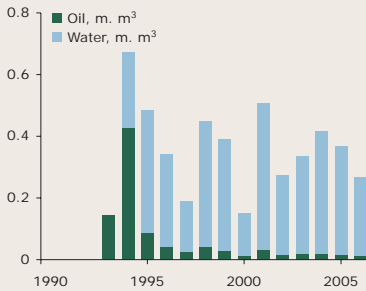


## FIELD DATA at 1 January 2007

Prospect:	Niils
Location:	Block 5505/17
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1979
Year on stream:	1993
Producing wells:	1
Water depth:	45 m
Field delineation:	20 km <sup>2</sup>
Reservoir depth:	1,700 m
Reservoir rock:	Chalk and Carbonates
Geological age:	Upper Cretaceous and Zechstein

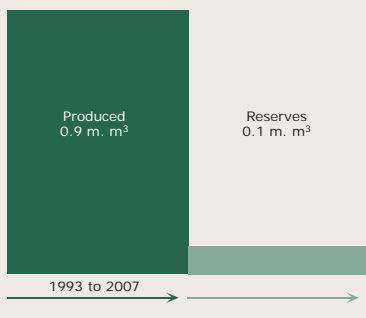
## PRODUCTION

Cum. production at 1 January 2007	
Oil:	0.93 m. m <sup>3</sup>
Gas:	0.06 bn. Nm <sup>3</sup>
Water:	4.06 m. m <sup>3</sup>



## RESERVES

Oil:	0.1 m. m <sup>3</sup>
Gas:	0.0 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Regnar Field is an anticlinal structure, induced through salt tectonics. The reservoir is heavily fractured.

## PRODUCTION STRATEGY

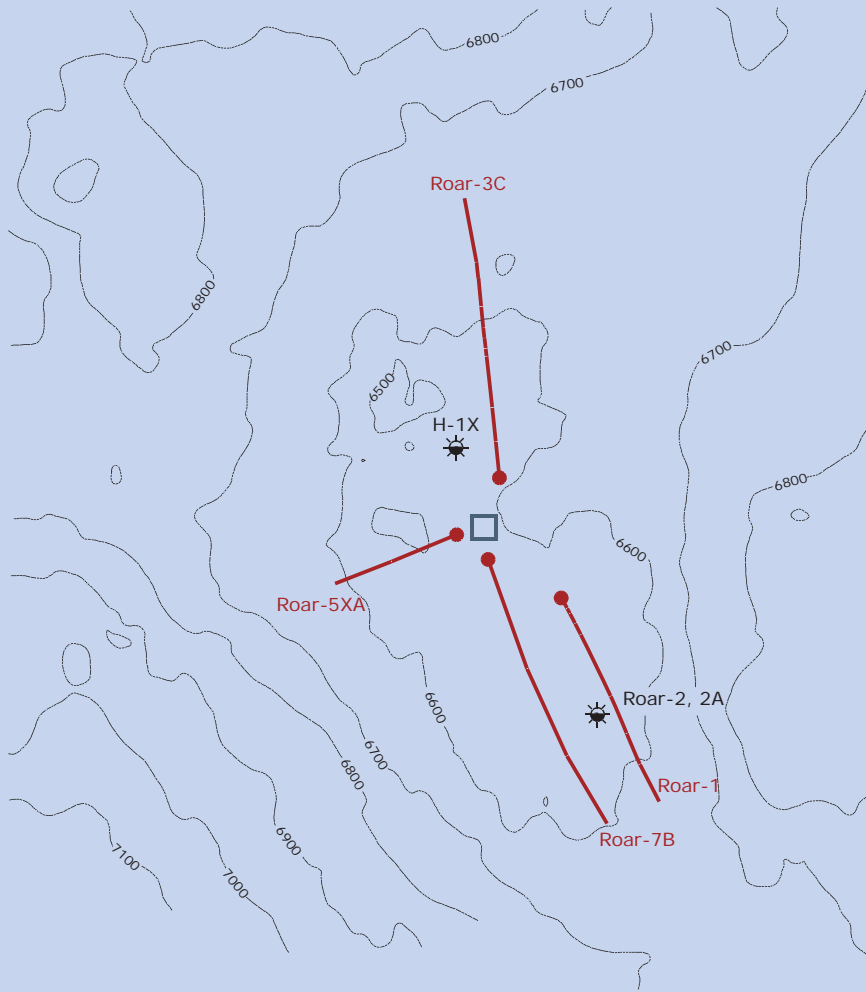
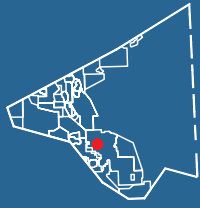
Production in the Regnar Field takes place from one vertical well on the crest of the structure. The oil is displaced towards the producing well by water flowing in from the underlying aquifer. The production strategy is to displace and produce as much of the oil as possible from the tight matrix of the formation.

## PRODUCTION FACILITIES

The Regnar Field has been developed as a satellite to the Dan Field. Production takes place in a subsea-completed well. The production is transported by pipeline in multi-phase flow to Dan F for processing and export ashore.

The well is remotely monitored and controlled from the Dan FC platform.

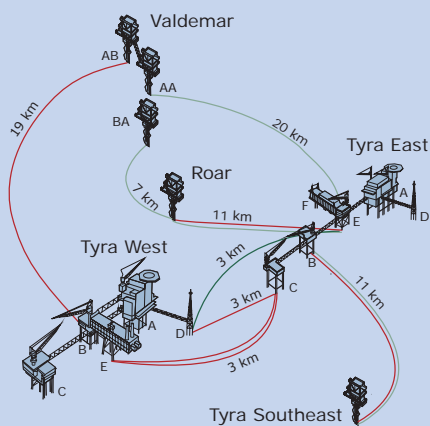
# THE ROAR FIELD



- Platform
- Gas well
- Well trajectory

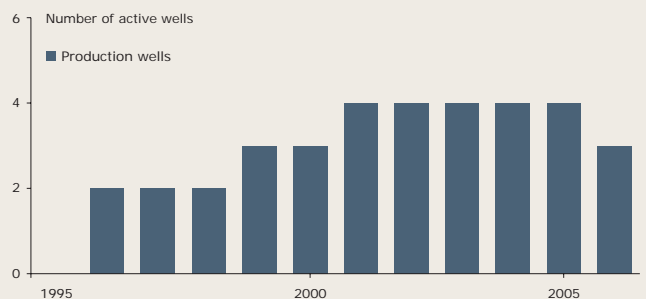
**Roar Field**  
Top Chalk

Depth structure map in feet  
0 1 2 km



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 0.6 billion

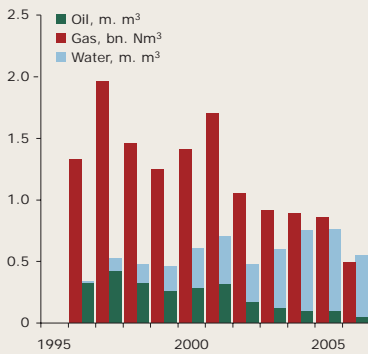


## FIELD DATA at 1 January 2007

Prospect:	Bent
Location:	Block 5504/7
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1968
Year on stream:	1996
Gas-producing wells: 4	
Water depth:	46 m
Field delineation:	41 km <sup>2</sup>
Reservoir depth:	2,025 m
Reservoir rock:	Chalk
Geological age:	Danian and Upper Cretaceous

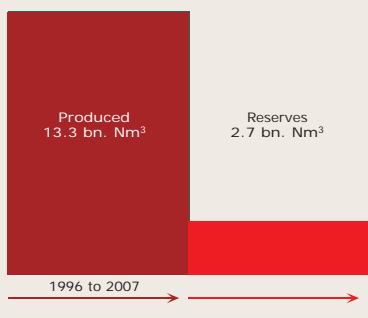
## PRODUCTION

Cum. production at 1 January 2007	
Oil and condensate:	2.47 m. m <sup>3</sup>
Gas:	13.32 bn. Nm <sup>3</sup>
Water:	3.75 m. m <sup>3</sup>



## RESERVES

Oil and condensate:	0.3 m. m <sup>3</sup>
Gas:	2.7 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Roar Field is an anticlinal structure induced through tectonic uplift. The accumulation consists of free gas containing condensate. The reservoir is only slightly fractured.

## PRODUCTION STRATEGY

Recovery from the Roar Field takes place by gas expansion. The production strategy for the Roar Field is to optimize the production of liquid hydrocarbons in the Tyra Field by maximizing production from the other gas fields and thus minimizing the drainage from Tyra.

## PRODUCTION FACILITIES

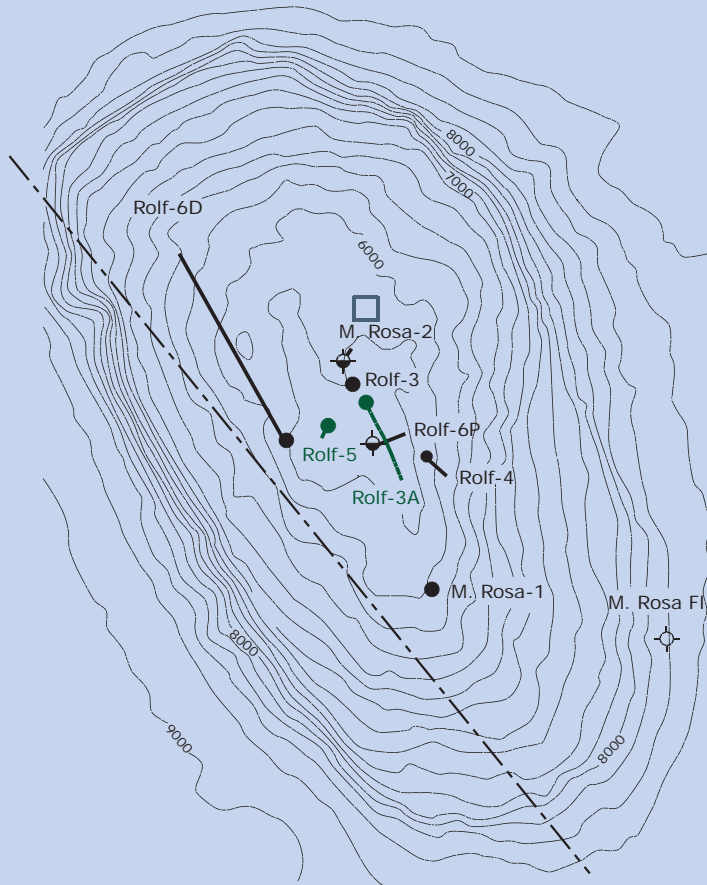
The Roar Field has been developed as a satellite to the Tyra Field with an unmanned wellhead platform of the STAR type, without a helideck. The production is separated into gas and liquids before being transported to Tyra East in two pipelines for further processing and subsequent export ashore. A pipeline from Tyra East supplies chemicals to the Roar platform.

In 2007, the gas pipeline between Roar and Tyra East was decommissioned. A new 16" multiphase pipeline has been established from the Valdemar BA platform to Tyra East via the Roar Field, which transports the gas from Roar to Tyra East.

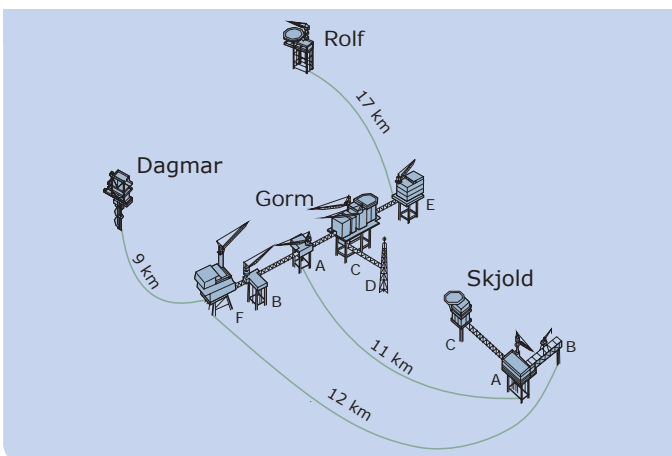
# THE ROLF FIELD



- Platform
- Oil well
- Closed oil well
- Well trajectory

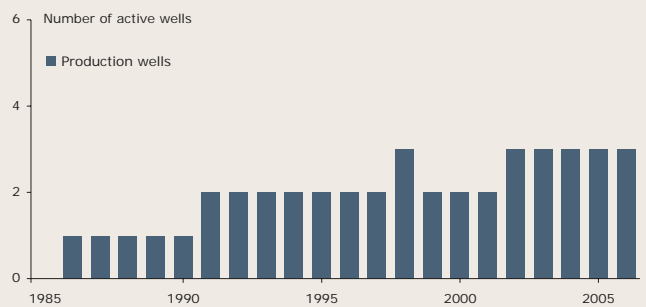


**Rolf Field**  
**Top Chalk**  
 Depth structure map in feet



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
 2006 prices DKK 1.0 billion



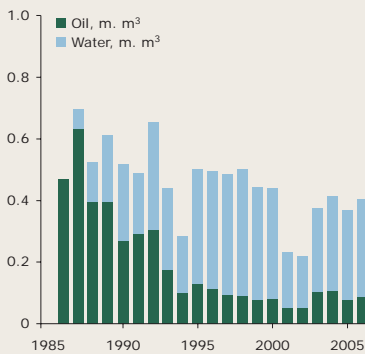
## FIELD DATA at 1 January 2007

Prospect:	Middle Rosa
Location:	Blocks 5504/14 and 15
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1981
Year on stream:	1986
Producing wells:	2
Water depth:	34 m
Area:	8 km <sup>2</sup>
Reservoir depth:	1,800 m
Reservoir rock:	Chalk and Carbonates
Geological age:	Danian, Upper Cretaceous and Zechstein

## PRODUCTION

Cum. production at 1 January 2007

Oil:	4.11 m. m <sup>3</sup>
Gas:	0.17 bn. Nm <sup>3</sup>
Water:	5.46 m. m <sup>3</sup>



## RESERVES

Oil:	0.6 m. m <sup>3</sup>
Gas:	0.0 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Rolf Field is an anticlinal structure, induced through salt tectonics. The reservoir is heavily fractured.

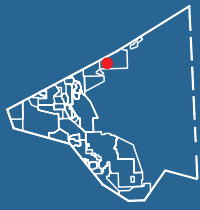
## PRODUCTION STRATEGY

Production from the Rolf Field takes place from two wells drilled in the crest of the structure. The oil is displaced towards the producing wells by the water flow from an underlying aquifer. The natural influx of water from the water zone corresponds to the volume removed due to production in the central part of the structure.

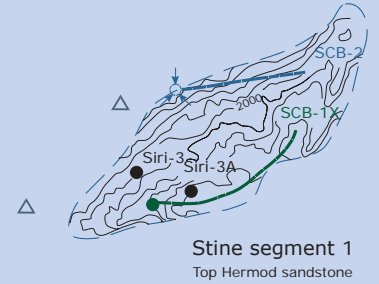
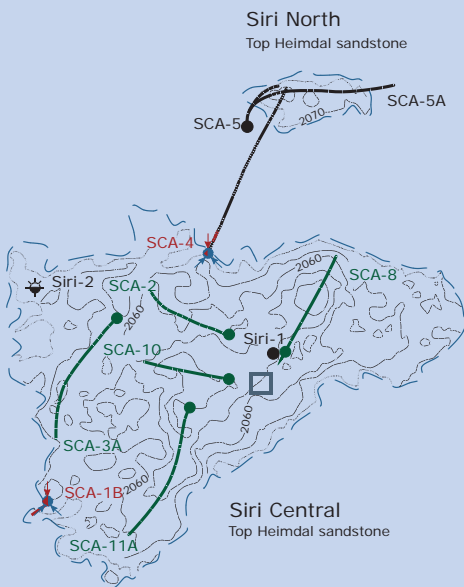
## PRODUCTION FACILITIES

The Rolf Field is a satellite development to the Gorm Field with one unmanned well-head platform with a helideck. The production is transported to the Gorm C platform for processing. Rolf is also supplied with power and lift gas from the Gorm Field.

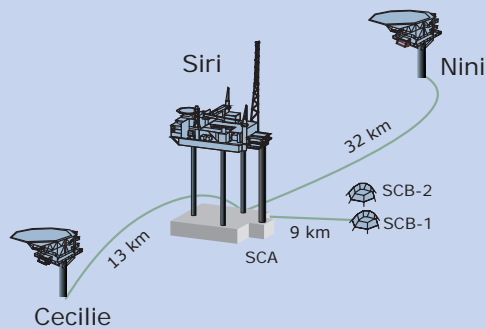
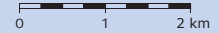
# THE SIRI FIELD



- Platform
- Subsea installation
- Oil well
- Gas- and water-injection well
- Closed well
- Well trajectory
- Closed well trajectory

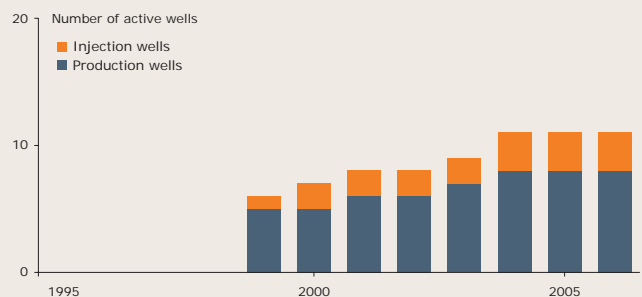


**Siri Field**  
Depth structure map in metres



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 5.1 billion





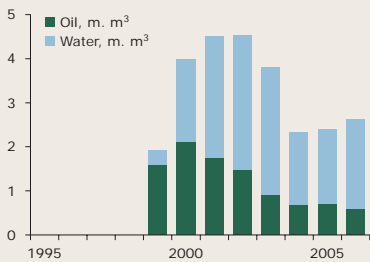
## FIELD DATA at 1 January 2007

Location:	Block 5604/20
Licence:	6/95
Operator:	DONG E&P A/S
Discovered:	1995
Year on stream:	1999
Producing wells:	5 (Siri central) 1 (Stine segment 1) 2 (Stine segment 2)
Water-/Gas- injection wells:	2 (Siri central)
Water-injection wells:	1 (Stine segment 1)
Water depth:	60 m
Field delineation:	42 km <sup>2</sup>
Reservoir depth:	2,060 m
Reservoir rock:	Sandstone
Geological age:	Paleocene

## PRODUCTION

Cum. production at 1 January 2007

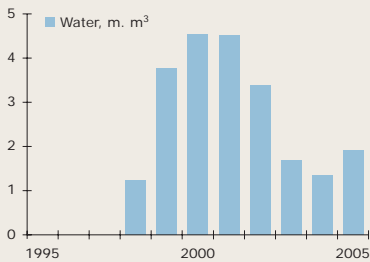
Oil:	9.87 m. m <sup>3</sup>
Gas:	1.02 bn. Nm <sup>3</sup>
Water:	16.24 m. m <sup>3</sup>



## INJECTION

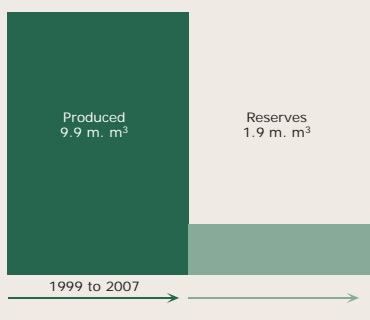
Cum. injection at 1 January 2007

Gas:	0.92 bn. Nm <sup>3</sup>
Water:	22.40 m. m <sup>3</sup>



## RESERVES

Oil:	1.9 m. m <sup>3</sup>
Gas:	0.0 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Siri Field is a structural trap with a Paleocene sandstone reservoir. The accumulation consists of oil with a relatively low content of gas.

## PRODUCTION STRATEGY

Recovery takes place from Siri Central as well as from the neighbouring Stine segments 1 and 2. The strategy for producing oil from Siri Central is to maintain reservoir pressure by means of the co-injection of water and gas. In addition, gas from the Cecilie and Nini Fields is injected into the Siri Field.

The recovery from Stine segment 1 is based on water injection to maintain reservoir pressure. Previously, recovery from Stine segment 2 was based on natural depletion, but water injection was initiated in 2006.

## PRODUCTION FACILITIES

The Siri Central and Stine segment 2 installations comprise a combined wellhead, processing and accommodation platform. The processing facilities consist of a separation plant that treats the hydrocarbons produced from Siri/Stine and from Nini and Cecilie. The water produced in the Siri Field and satellite fields is processed at Siri and is normally injected into the Siri Field and its satellite fields.

The Stine segment 1 facilities consist of a subsea installation with wellheads placed directly on the seabed. A 6" multiphase pipeline transports the production to the Siri platform. Lift gas and injection water are supplied from the Siri platform.

The oil produced is conveyed to a 50,000 m<sup>3</sup> storage tank on the seabed and is exported ashore by tanker.

The Siri Field has accommodation facilities for 60 persons.



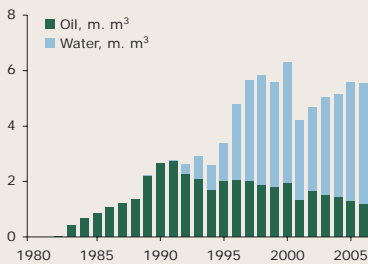
## FIELD DATA at 1 January 2007

Prospect:	Ruth
Location:	Block 5504/16
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1977
Year on stream:	1982
Producing wells:	19
Water-injection wells:	9
Water depth:	40 m
Field delineation:	33 km <sup>2</sup>
Reservoir depth:	1,600 m
Reservoir rock:	Chalk
Geological age:	Danian, Upper Cretaceous and Zechstein

## PRODUCTION

Cum. production at 1 January 2007

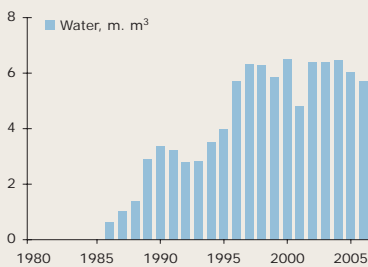
Oil:	39.56 m. m <sup>3</sup>
Gas:	3.27 bn. Nm <sup>3</sup>
Water:	43.52 m. m <sup>3</sup>



## INJECTION

Cum. injection at 1 January 2007

Water:	92.21 m. m <sup>3</sup>
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## RESERVES

Oil:	8.4 m. m <sup>3</sup>
Gas:	0.7 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Skjold Field is an anticlinal structure, induced through salt tectonics. The reservoir is intersected by numerous, minor faults in the central part of the structure. At the flanks of the structure, the reservoir is less fractured. Unusually favourable production properties have been shown to exist in the reservoir.

## PRODUCTION STRATEGY

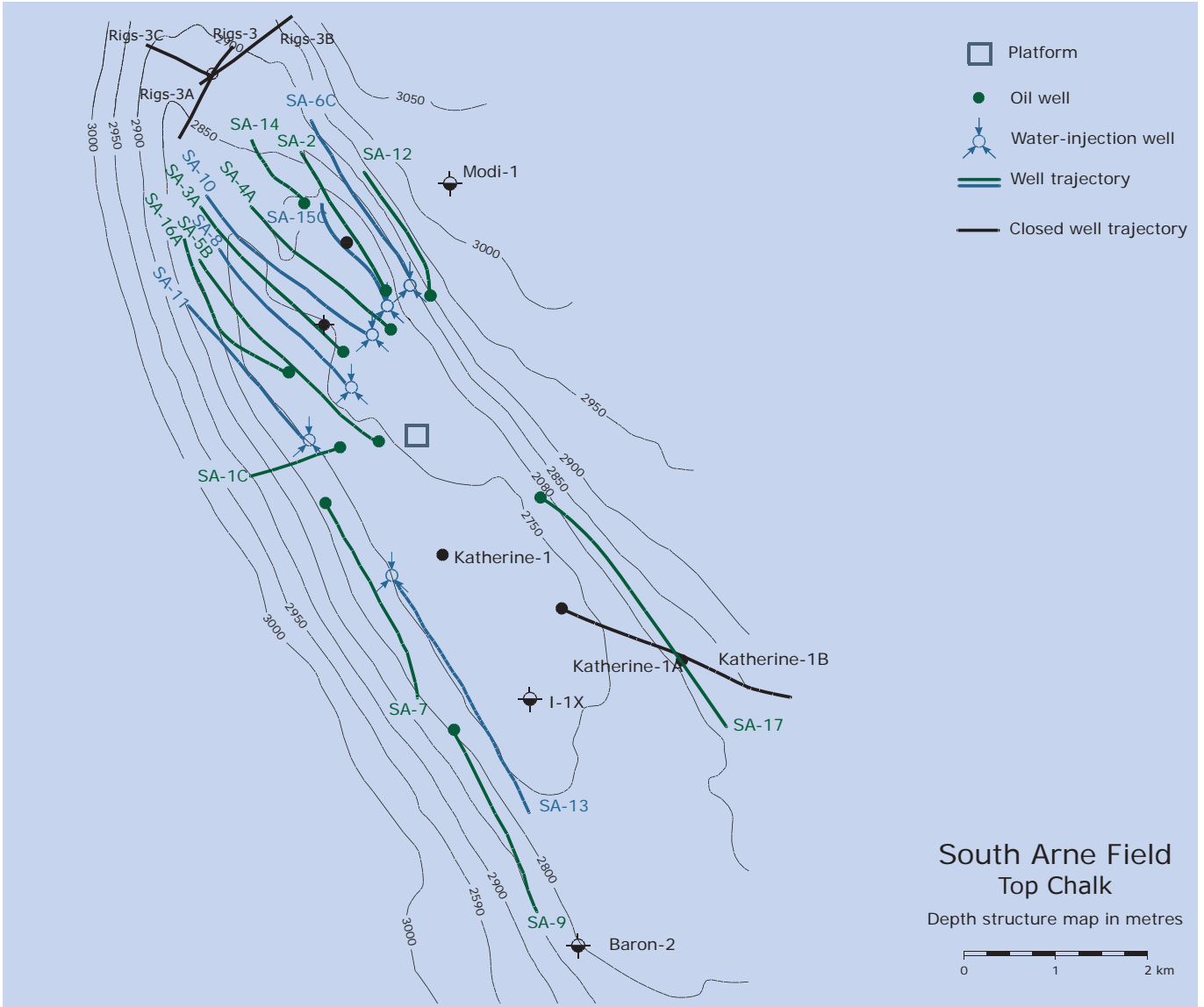
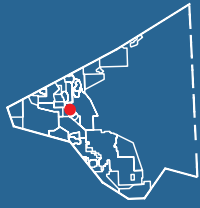
The strategy for producing oil from Skjold is to maintain reservoir pressure by means of water injection. Oil is mainly produced from horizontal wells at the flanks of the reservoir, where the production and injection wells are placed alternately in a radial pattern.

## PRODUCTION FACILITIES

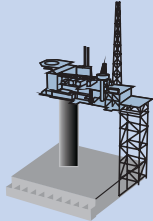
The Skjold Field comprises a satellite development to the Gorm Field, including two wellhead platforms, Skjold A and B, as well as an accommodation platform, Skjold C. There are no processing facilities at the Skjold Field, and the production is transported to the Gorm F platform for processing. The Gorm facilities provide the Skjold Field with injection water and lift gas.

The Skjold C platform has accommodation facilities for 16 persons.

# THE SOUTH ARNE FIELD

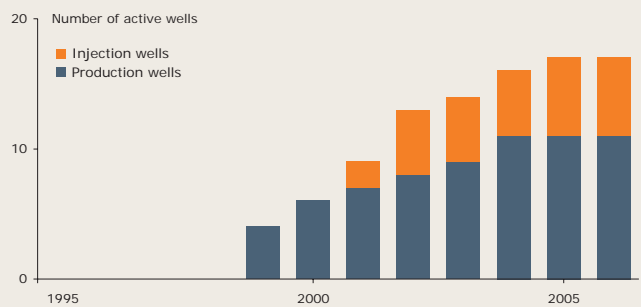


## South Arne



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 9.6 billion



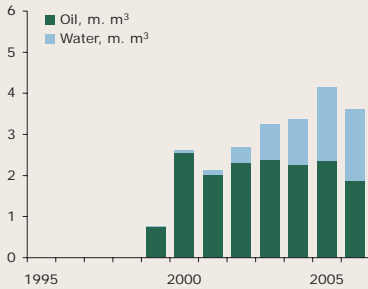
## FIELD DATA at 1 January 2007

Location:	Blocks 5604/29 and 30
Licence:	7/89
Operator:	Hess Denmark ApS
Discovered:	1969
Year on stream:	1999
Producing wells:	11
Water-injection wells:	6
Water depth:	60 m
Field delineation:	93 km <sup>2</sup>
Reservoir depth:	2,800 m
Reservoir rock:	Chalk
Geological age:	Danian, Upper Cretaceous and Lower Cretaceous

## PRODUCTION

Cum. production at 1 January 2007

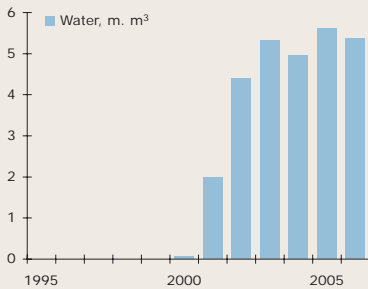
Oil:	16.54 m. m <sup>3</sup>
Gas:	4.19 bn. Nm <sup>3</sup>
Water:	6.03 m. m <sup>3</sup>



## INJECTION

Cum. injection at 1 January 2007

Water:	27.67 m. m <sup>3</sup>
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## RESERVES

Oil:	12.9 m. m <sup>3</sup>
Gas:	5.7 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

South Arne is an anticlinal structure, induced through tectonic uplift, which has caused the chalk to fracture. The structure contains oil with a relatively high content of gas.

## PRODUCTION STRATEGY

The production of hydrocarbons is based on pressure support from water injection.

## PRODUCTION FACILITIES

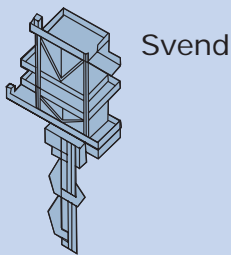
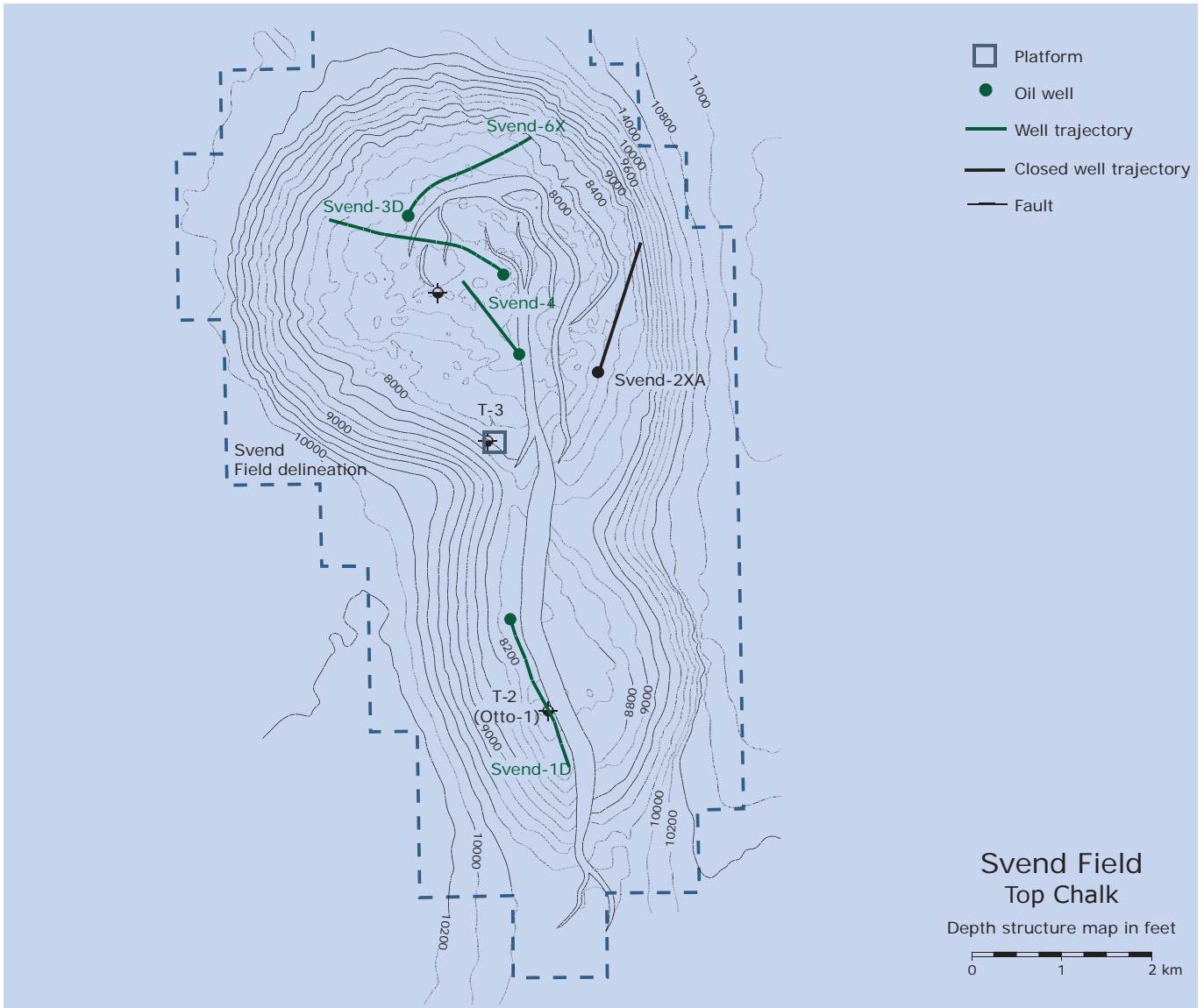
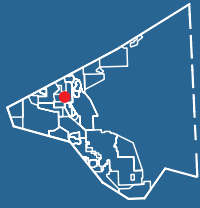
The South Arne Field installations comprise a combined wellhead, processing and accommodation platform.

The processing facilities consist of a plant that separates the hydrocarbons produced as well as gas-processing facilities. In addition, processing facilities have been installed to treat the injection water before it is injected. Some of the water produced is injected into the field, while the rest is processed and discharged into the sea.

The oil produced is conveyed to an 87,000 m<sup>3</sup> storage tank on the seabed and is exported ashore by tanker. The gas produced is exported through a gas pipeline to Nybro on the west coast of Jutland.

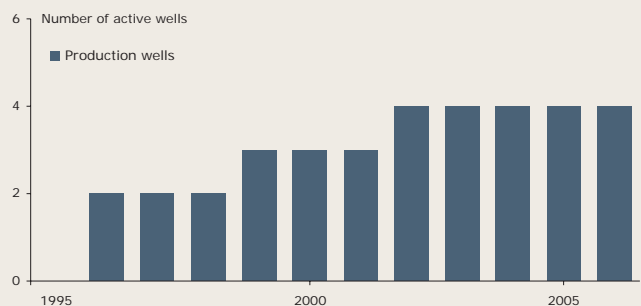
The South Arne Field has accommodation facilities for 57 persons.

# THE SVEND FIELD



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 1.2 billion



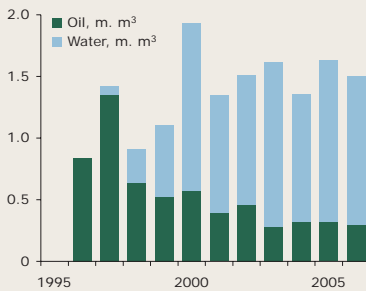
## FIELD DATA at 1 January 2007

Prospect:	North Arne/Otto
Location:	Block 5604/25
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1975 (North Arne) 1982 (Otto)
Year on stream:	1996
Producing wells:	4
Water depth:	65 m
Field delineation:	48 km <sup>2</sup>
Reservoir depth:	2,500 m
Reservoir rock:	Chalk
Geological age:	Danian and Upper Cretaceous

## PRODUCTION

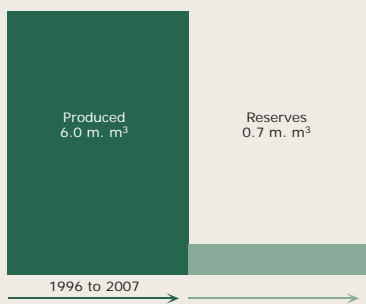
Cum. production at 1 January 2007

Oil:	6.0 m. m <sup>3</sup>
Gas:	0.71 bn. Nm <sup>3</sup>
Water:	9.16 m. m <sup>3</sup>



## RESERVES

Oil:	0.7 m. m <sup>3</sup>
Gas:	0.1 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Svend Field is an anticlinal structure, induced through salt tectonics. This led to fracturing of the chalk in the reservoir and divided the field into a western and an eastern block, separated by a major fault. The northern reservoir of the Svend Field is situated about 250 metres higher than the southern reservoir. The northern reservoir has proved to have unusually favourable production properties.

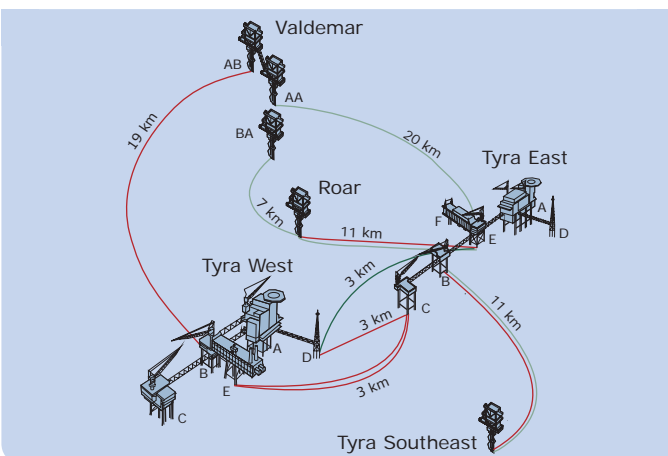
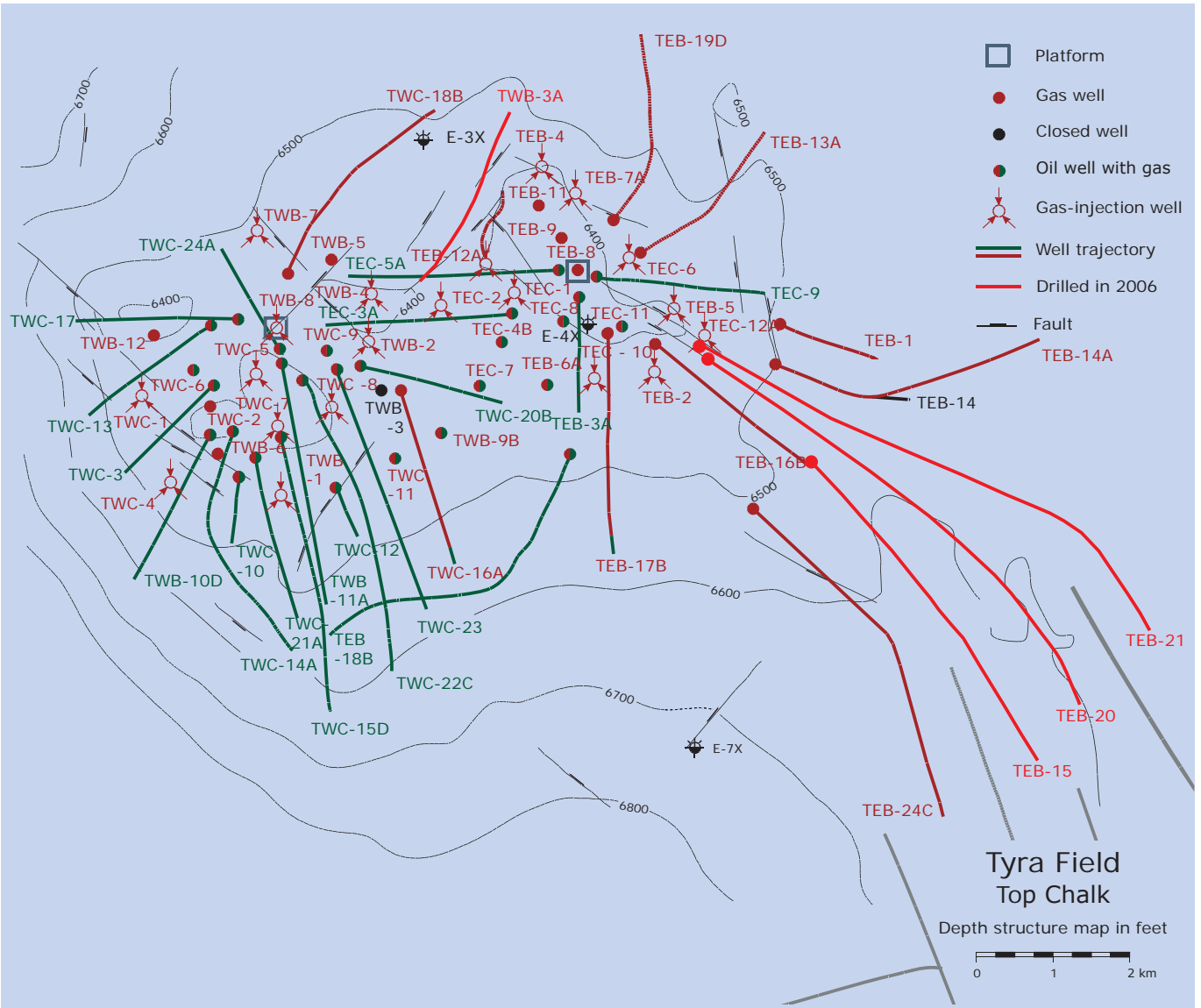
## PRODUCTION STRATEGY

Oil production from the Svend Field is based on primary recovery at a reservoir pressure above the bubble point of the oil.

## PRODUCTION FACILITIES

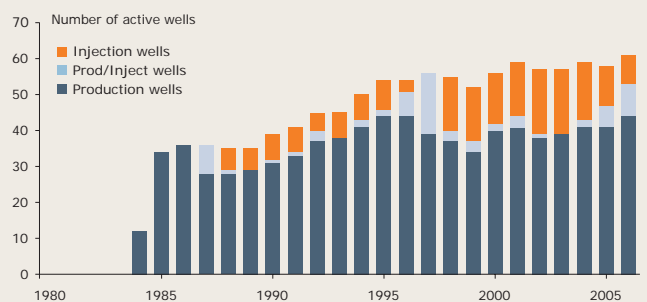
Svend is a satellite development to the Tyra Field with one unmanned wellhead platform without a helideck. The hydrocarbons produced are piped to Tyra East for processing and export ashore. The Svend Field is connected to the 16" pipeline from Harald to Tyra East.

# THE TYRA FIELD



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 27.7 billion





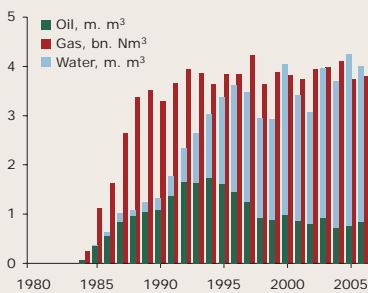
## FIELD DATA at 1 January 2007

Prospect:	Cora
Location:	Blocks 5504/11 and 12
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1968
Year on stream:	1984
Gas-producing wells:	19
Oil-/Gas-prod. wells:	28
Producing/Inj. wells:	20
Water depth:	37-40 m
Area:	90 km <sup>2</sup>
Reservoir depth:	2,000 m
Reservoir rock:	Chalk
Geological age:	Danian and Upper Cretaceous

## PRODUCTION

Cum. production at 1 January 2007

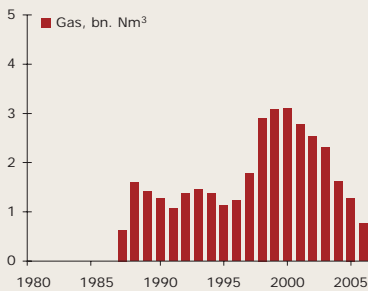
Oil and condensate:	23.45 m. m <sup>3</sup>
Gas:	77.55 bn. Nm <sup>3</sup>
Water:	34.82 m. m <sup>3</sup>



## INJECTION

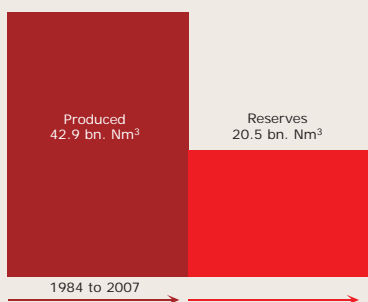
Cum. injection at 1 January 2007

Gas:	34.67 bn. Nm <sup>3</sup>
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## RESERVES

Oil and condensate:	5.4 m. m <sup>3</sup>
Gas:	20.5 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Tyra Field is an anticlinal structure created by tectonic uplift. The accumulation consists of free gas containing condensate, overlying a thin oil zone. The reservoir is only slightly fractured.

## PRODUCTION STRATEGY

The Tyra Field acts as a gas production buffer so as not to deteriorate condensate and oil production conditions by reducing the reservoir pressure at too early a stage. Thus, increased gas production from DUC's other fields, in particular the Harald and Roar gas fields, optimizes the recovery of liquid hydrocarbons from the Tyra Field.

## PRODUCTION FACILITIES

The Tyra Field installations comprise two platform complexes, Tyra West (TW) and Tyra East (TE).

Tyra West consists of two wellhead platforms, TWB and TWC, one processing and accommodation platform, TWA, and one gas flare stack, TWD, as well as a bridge module installed at TWB and supported by a four-legged jacket, TWE.

The Tyra West processing facilities include a plant for pre-processing oil and condensate production from the wells at Tyra West. Moreover, the Tyra West complex houses gas-processing facilities and facilities for the injection and/or export of gas and processing facilities for the water produced. Tyra West receives part of the gas produced at Halfdan and Valdemar.

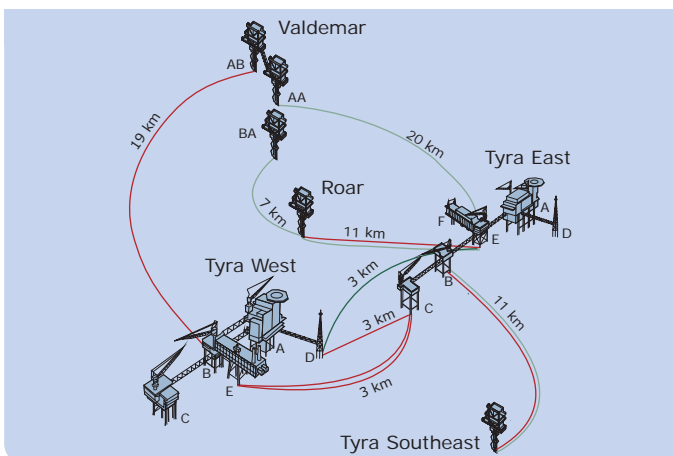
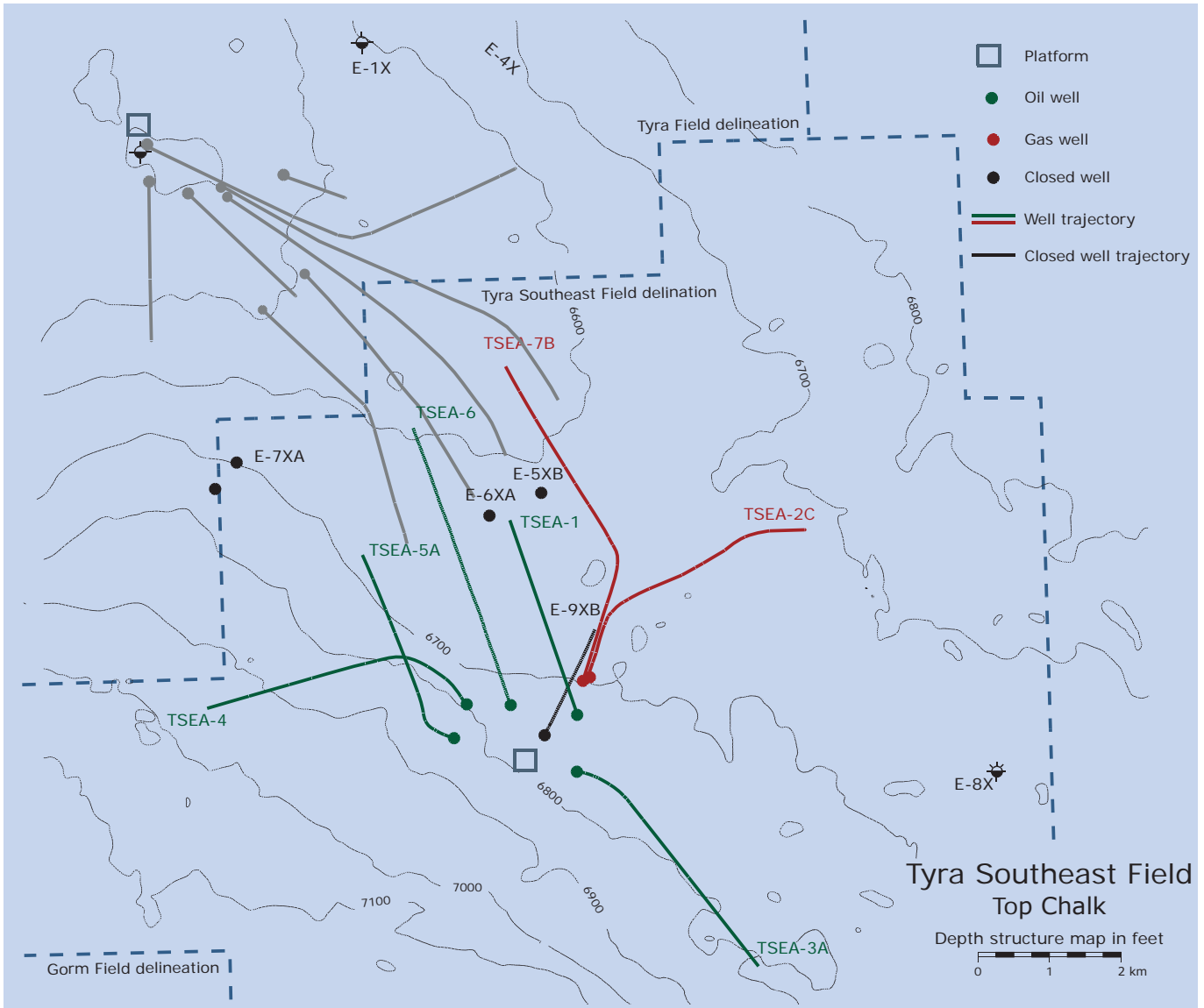
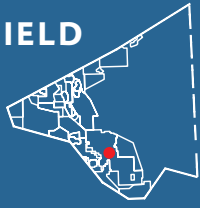
Tyra East consists of two wellhead platforms, TEB and TEC, one processing and accommodation platform, TEA, one gas flare stack, TED, and one riser platform, TEE, as well as a bridge module supported by a STAR jacket, TEF.

Tyra East receives production from the satellite fields, Valdemar, Roar, Svend, Tyra Southeast and Harald/Lulita, as well as gas production from the Gorm and Dan Fields. The Tyra East complex includes facilities for the final processing of gas, oil, condensate and water. Treated production water from the whole of the Tyra Field is discharged into the sea.

The two platform complexes in the Tyra Field are interconnected by pipelines in order to yield the maximum operational flexibility and reliability of supply. Oil and condensate production from the Tyra Field and its satellite fields is transported ashore via Gorm E, while the bulk of gas produced is transported from TEE at Tyra East to shore and the rest is transported from TWE at Tyra West to the NOGAT pipeline.

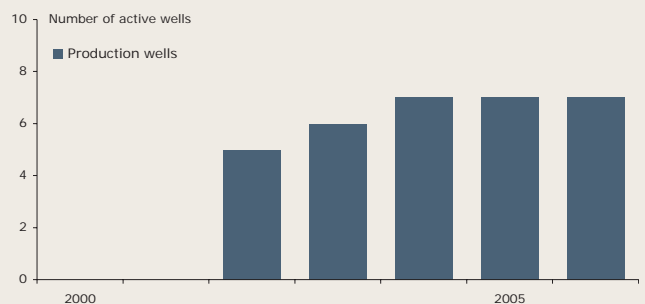
Tyra East has accommodation facilities for 96 persons, while there are accommodation facilities for 80 persons at Tyra West.

# THE TYRA SOUTHEAST FIELD



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 1.2 billion



## FIELD DATA at 1 January 2007

Location: Block 5504/12  
 Licence: Sole Concession  
 Operator: Mærsk Olie og Gas AS  
 Discovered: 1991  
 Year on stream: 2002

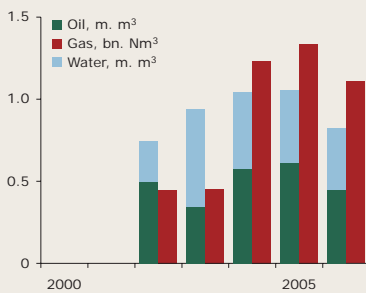
Oil-producing wells: 5  
 Gas-producing wells: 2

Water depth: 38 m  
 Field delineation: 113 km<sup>2</sup>  
 Reservoir depth: 2,050 m  
 Reservoir rock: Chalk  
 Geological age: Danian and Upper Cretaceous

## PRODUCTION

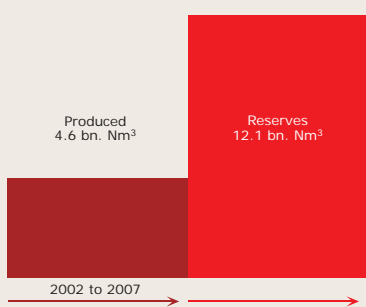
Cum. production at 1 January 2007

Oil: 2.48 m. m<sup>3</sup>  
 Gas: 4.58 bn. Nm<sup>3</sup>  
 Water: 2.13 m. m<sup>3</sup>



## RESERVES

Oil: 2.6 m. m<sup>3</sup>  
 Gas: 12.1 bn. Nm<sup>3</sup>



## REVIEW OF GEOLOGY

The Tyra Southeast Field is an anticlinal structure created by a slight tectonic uplift of Upper Cretaceous chalk layers. The structure is divided into two blocks separated by a northeastern-southwestern fault zone. The structure is part of the major uplift zone that also comprises Roar, Tyra and parts of the Halfdan Field.

The Tyra Southeast accumulation contains free gas overlying an oil zone in the south-eastern part of the field.

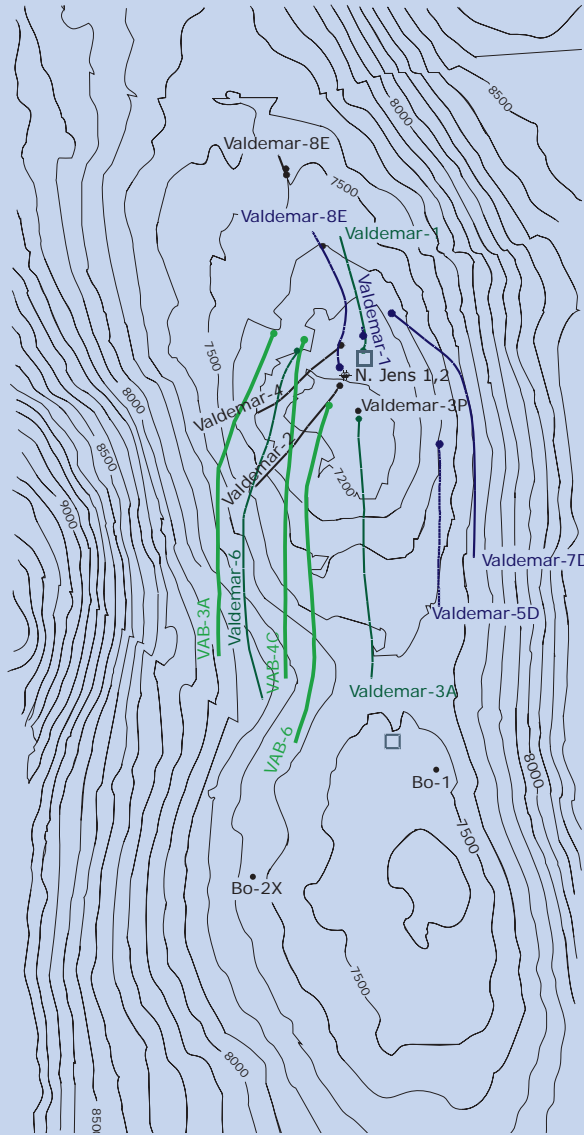
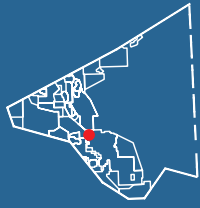
## PRODUCTION STRATEGY

The production of oil and gas is based on natural depletion.

## PRODUCTION FACILITIES

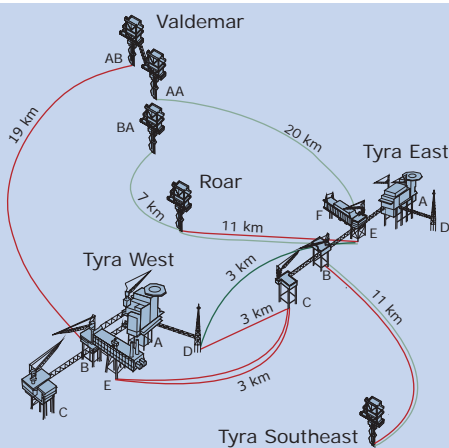
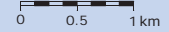
The Tyra Southeast Field has been developed as a satellite to the Tyra Field with an unmanned platform. The production is separated into gas and liquids before being transported to Tyra East for further processing.

# THE VALDEMAR FIELD



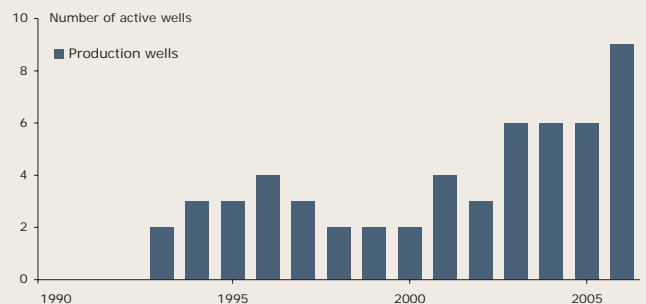
- Platform
- Oil well
- Closed well
- Well trajectory in Upper Cretaceous
- Drilled in 2006
- Well trajectory
- Closed well trajectory
- Fault

Valdemar Field  
Top Tuxen Chalk  
Depth structure map in feet



## DEVELOPMENT AND INVESTMENT

Total investments at 1 January 2007  
2006 prices DKK 3.5 billion

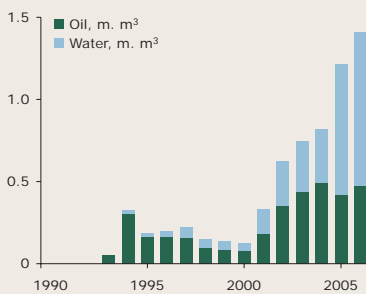


## FIELD DATA at 1 January 2007

Prospect:	Bo/North Jens
Location:	Blocks 5504/7 and 11
Licence:	Sole Concession
Operator:	Mærsk Olie og Gas AS
Discovered:	1977 (Bo) 1985 (North Jens)
Year on stream:	1993 (North Jens)
Producing wells:	9
Water depth:	38 m
Field delineation:	96 km <sup>2</sup>
Reservoir depth:	2,000 m (Upper Cretaceous) 2,600 m (Lower Cretaceous)
Reservoir rock:	Chalk
Geological age:	Danian, Upper and Lower Cretaceous

## PRODUCTION

Cum. production at 1 January 2007	
Oil:	3.45 m. m <sup>3</sup>
Gas:	1.45 bn. Nm <sup>3</sup>
Water:	3.08 m. m <sup>3</sup>



## RESERVES

Oil:	6.7 m. m <sup>3</sup>
Gas:	5.1 bn. Nm <sup>3</sup>



## REVIEW OF GEOLOGY

The Valdemar Field consists of a northern reservoir called North Jens and a southern reservoir called Bo, which are both anticlinal chalk structures associated with tectonic uplift.

Valdemar comprises several separate reservoirs. Oil and gas have been discovered in Danian/Upper Cretaceous chalk, and large volumes of oil-in-place have been identified in Lower Cretaceous chalk. The properties of the Upper Cretaceous reservoirs are comparable to other Danish fields like Gorm and Tyra, whereas the Lower Cretaceous chalk possesses challenging production properties due to extremely low permeability in some parts of the Valdemar Field.

However, an appraisal well in the Bo area has shown that other parts of the Lower Cretaceous have better production properties. This has led to the development of the Bo reservoir.

## PRODUCTION STRATEGY

The production of oil from the field is based on primary recovery. The development of a production method based on long horizontal wells with numerous sand-filled, artificial fractures has made it possible to exploit the Lower Cretaceous reservoir commercially. In addition, recovery takes place from Danian/Upper Cretaceous layers.

## PRODUCTION FACILITIES

The North Jens area of the Valdemar Field has been developed as a satellite to the Tyra Field with two bridge-connected, unmanned wellhead platforms, Valdemar AA and AB. Production is separated at the Valdemar AB platform. The liquids produced are piped to Tyra East for processing and export ashore, while the gas produced is piped to Tyra West. The Valdemar AA/AB complex is provided with chemicals from Tyra East and with power from Tyra West.

Production from the Bo area of the Valdemar Field is expected to start in 2007.

## APPENDIX C: FINANCIAL KEY FIGURES

	Investments in field dev. DKK million 5)	Field operating costs DKK million 1)	Exploration costs DKK million	Crude oil price USD/bbl 2)	Exchange rate DKK/USD	Inflation per cent 3)	Net foreign-currency value DKK billion 4)	State revenue DKK million
1972	105	29	30	3.0	7.0	6.7	-3.2	-
1973	9	31	28	4.6	6.1	9.3	-4.0	1
1974	38	57	83	11.6	6.1	15.3	-9.2	1
1975	139	62	76	12.3	5.8	9.6	-8.5	2
1976	372	70	118	12.9	6.1	9.0	-9.5	4
1977	64	85	114	14.0	6.0	11.1	-10.4	5
1978	71	120	176	14.1	5.5	10.0	-9.5	21
1979	387	143	55	20.4	5.3	9.6	-13.7	19
1980	956	163	78	37.5	5.6	12.3	-18.6	29
1981	1,651	320	201	37.4	7.1	11.7	-20.1	36
1982	3,884	534	257	34.0	8.4	10.1	-20.6	231
1983	3,554	544	566	30.5	9.1	6.9	-17.8	401
1984	1,598	1,237	1,211	28.2	10.4	6.3	-18.3	564
1985	1,943	1,424	1,373	27.2	10.6	4.7	-17.6	1,192
1986	1,651	1,409	747	14.9	8.1	3.7	-7.3	1,399
1987	930	1,380	664	18.3	6.8	4.0	-5.9	1,328
1988	928	1,413	424	14.8	6.7	4.5	-3.7	568
1989	1,162	1,599	366	18.2	7.3	4.8	-3.2	1,024
1990	1,769	1,654	592	23.6	6.2	2.6	-2.7	2,089
1991	2,302	1,898	985	20.0	6.4	2.4	-1.9	1,889
1992	2,335	1,806	983	19.3	6.0	2.1	-0.4	1,911
1993	3,307	2,047	442	16.8	6.5	1.2	-1.7	1,811
1994	3,084	2,113	151	15.6	6.4	2.0	-0.5	2,053
1995	4,164	1,904	272	17.0	5.6	2.1	0.3	1,980
1996	4,260	2,094	470	21.1	5.8	2.1	0.4	2,465
1997	3,760	2,140	515	18.9	6.6	2.2	1.4	3,171
1998	5,381	2,037	406	12.8	6.7	1.8	0.9	3,125
1999	3,531	2,118	656	17.9	7.0	2.5	3.5	3,630
2000	3,113	2,813	672	28.5	8.1	2.9	14.9	8,695
2001	4,025	2,756	973	24.4	8.3	2.4	12.6	9,634
2002	5,475	3,102	1,036	24.9	7.9	2.4	14.5	10,137
2003	7,386	3,522	789	28.8	6.6	2.1	15.3	9,255
2004	5,107	3,349	340	38.2	6.0	1.2	19.7	17,092
2005	3,983	3,760	582	54.4	6.0	1.8	24.8	24,163
2006*	5,560	4,131	784	65.1	5.9	1.9	30.8	31,493

### Nominal prices

1) Incl. transportation costs

2) Brent crude oil

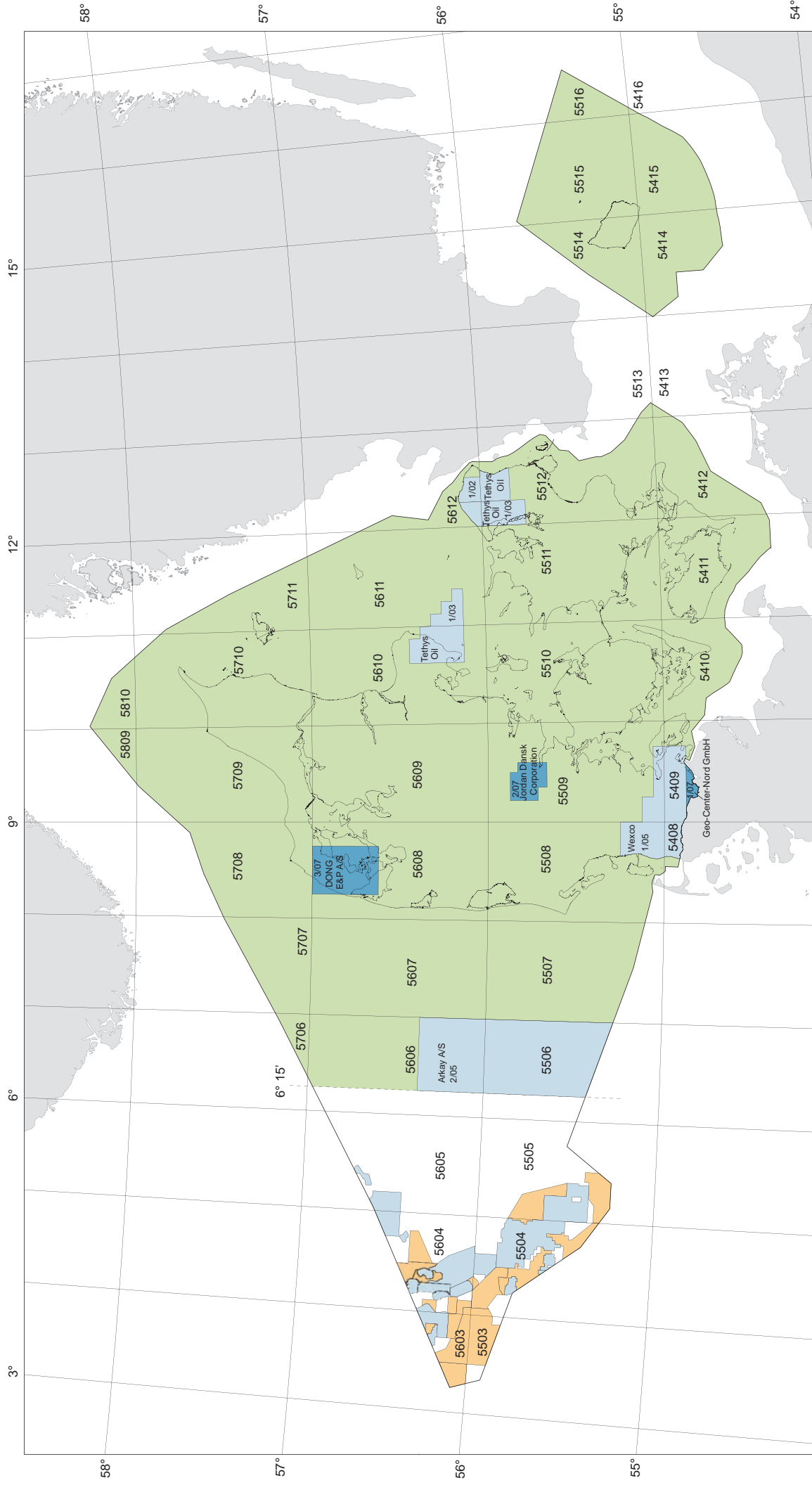
3) Consumer prices, source: Statistics Denmark

4) Surplus on the balance of trade for oil products and natural gas, source: external trade statistics, Statistics Denmark

5) Investments include the NOGAT pipeline

\*) Estimate

# Danish licence area - February 2007

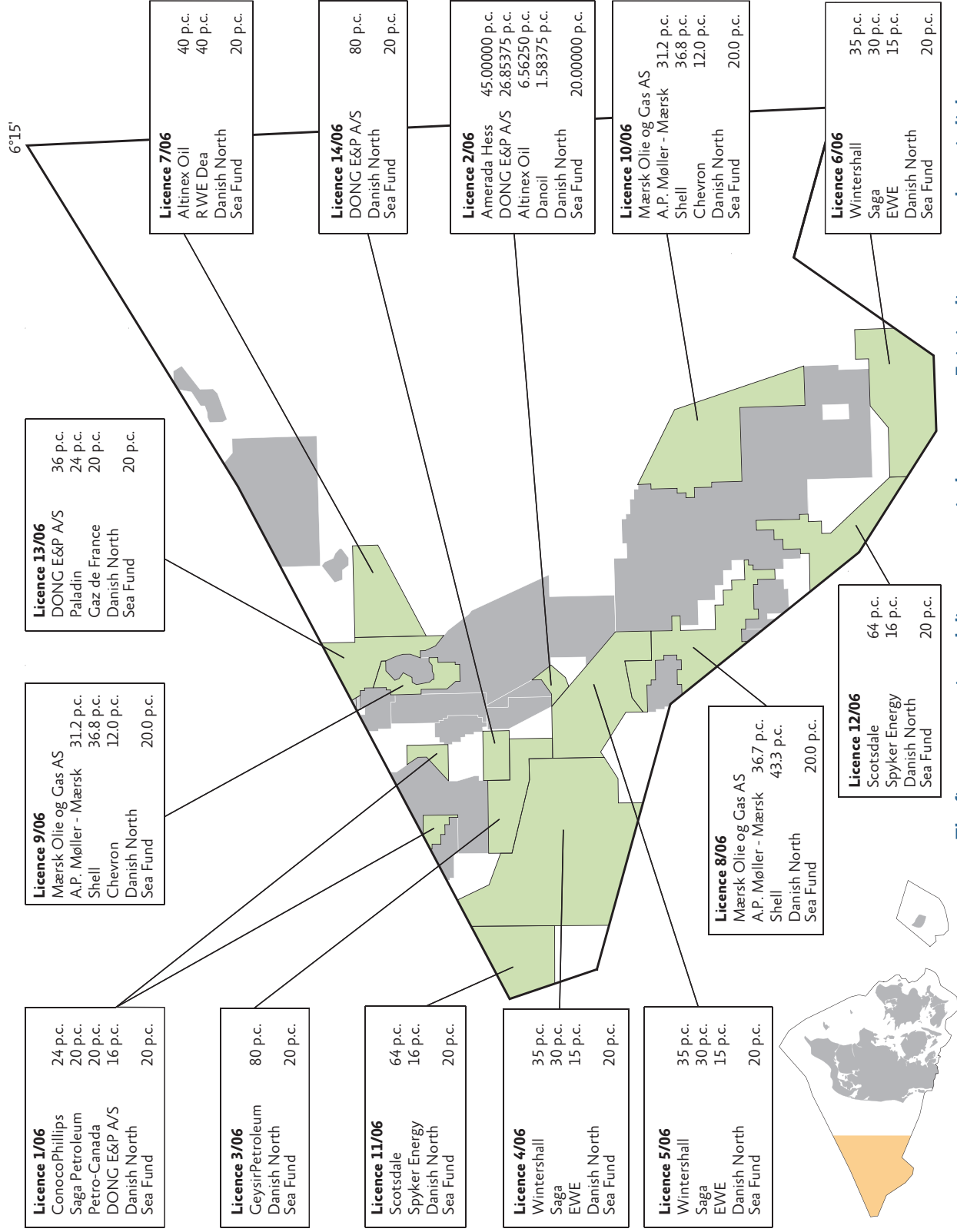


- 6th Round licences awarded in 2006
- Open Door licences awarded in 2007
- Licences awarded 1962-2005
- Open Door area





# Danish 6th Round licence awards



The first company in each licence group is the operator. Existing licences are shown in light grey.





