Report on socio-economic aspects

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In June 2003, the Greenland Government and the Danish Government, at the recommendation of the Joint Committee on Mineral Resources in Greenland, adopted a strategy for future oil and gas exploration in Greenland. The strategy means that there will be primary focus on the areas which, on the basis of current exploration knowledge, have the greatest exploration potential, i.e. parts of the area offshore central West Greenland and selected onshore and offshore areas near Disko-Nuussuaq between 68° and 71°N, where the most recent data indicates better prospectivity than previously assumed.

There is broad political agreement in Greenland to work towards developing the minerals sector into a sustainable industry which will make positive contributions to economic development and create new jobs. The objectives are an important part of the long-term economic policy to support development of alternative business sectors to fisheries, partly with a view to reducing the large current dependence on the annual block grant from Denmark.

Development of the hydrocarbon sector should take place in a manner which provides the greatest possible benefits for society in Greenland. Society must be secured a reasonable share of the surplus from exploitation, and local insight and knowledge about activities should be developed in order to, for example, ensure that local labour and local businesses are used as much as possible.

A clear political requirement for all oil and gas activities is that these are carried out safely and with due consideration for the environment. The Arctic environment is very vulnerable, and the Greenland commercial basis and culture is very much linked to nature and the environment.

Therefore, hydrocarbon activities should be promoted aiming at increasing employment and earnings. One requirement for making commercially viable finds which can support local employment and increase earnings is that exploration activities are maintained at a sufficiently high level.

As a result of the high costs of exploration in Greenland, it is important that the oil industry is responsible for a large part of the overall exploration activities. Therefore, an important strategic goal is to encourage interest from the industry in investing in oil exploration in Greenland. In this regard it is important that the authorities publish clear objectives and targets for how, when and on what terms they intend to offer exploration and exploitation licences in Greenland.

There is fierce competition between a number of countries throughout the world to attract the attention of the oil companies. Because of this it is very important to provide, as a minimum:

- geological data and surveys substantiating the potential for commercially viable deposits of hydrocarbons,
- competitive licence terms,
- stable framework conditions, and
- efficient processing by the authorities.

With this background, the main theme of the 2003 Hydrocarbon Strategy was to outline a number of specific action plans and timetables to encourage interest from the industry in investing in oil exploration in Greenland. A very concrete result of the Strategy is that a new oil licencing round was carried out in 2004 in four areas offshore West Greenland, and these resulted in a new exploration and exploitation licence. In accordance with the Hydrocarbon Strategy, at the end of 2004 the Greenland Government adopted an overall action plan aiming at making the Disko-Nuussuaq region and adjoining areas ready by the end of 2006 for the issue of new licences to the oil industry.

In continuation of the Hydrocarbon Strategy, the Greenland Government believes it necessary to issue a
1. Executive summary

long-term strategy for the socio-economic aspects of oil and gas activities, if the activities under the Hydrocarbon Strategy lead to findings of large amounts of oil and gas in Greenland’s subsoil.

As is well known, in 2004 a Greenlandic-Danish Home Rule Commission was established. The Commission is assigned to prepare a policy report on the possibilities for expanding Greenland’s self-governance within the framework of the Realm, based on the principle of balance between rights and obligations.

The Commission on Self-Governance has established two working groups under the Commission; one concerning non-living resources and one concerning economy and the development of commerce. The working group on non-living resources is to consider and propose future models for how administration of the area of non-living resources in Greenland can be transferred to Greenland. The terms of reference of both working groups state that the working group on economy is to deal with the question of how the possible revenues from raw material extraction in Greenland will relate to a new scheme for the economic relationship between Denmark and Greenland.

In light of the ongoing work in the Greenlandic-Danish Commission on Self-Governance, this report will not address the possible socio-economic effects of any changes to the Mineral Resources System. The System is described in brief in Chapter 2.

Status of previous exploration activities and targets and plans for future oil and gas exploration in Greenland is described in summary in Chapter 3.

Chapter 4 contains an assessment of the economic/fiscal aspects of oil exploration and exploitation in Greenland.

Section 4.1 presents the result of an international benchmark analysis of tax and royalty levels (Government take) in Greenland and in a number of comparable countries. This section asserts that the Greenland Government take is at a competitive level compared to competing areas, taking into account:

- public sector share of overall proceeds,
- the impact of royalty systems on companies’ inclination to invest in Greenland,
- geological risks associated with Greenland’s subsoil,
- logistics frameworks.

In Greenland a so-called progressive surplus royalty is charged, that is the public sector share of the proceeds increases when the proceeds from oil activities go up. Overall, Greenland thus has a Government-take model which does not deter oil companies from exploitation activities.

Section 4.2 contains a description of the prerequisites for exploiting an oilfield, the equivalent of 2 billion exploitable barrels, in one of the four offshore areas included in the 2004 licensing round. The example is based on geological interpretation of seismic data collected in the area covered by the licencing round, and a number of other factors of significance for choice of production technology, including sea depths, wind and current conditions, data on sea ice, icebergs, etc.

A calculation was carried out of the possible proceeds that will befall the public sector from exploitation of an oilfield such as this. It appears the revenue flows to the public sector will be considerable. However, there are a number of conditions that make the economic result of exploiting an oilfield of a given size uncertain. This also means that the public-sector share of the proceeds could vary considerably.
Section 4.3 indicates a possible model for how society can prepare an economic policy related to potential hydrocarbon activities in Greenland.

Although, actual oil production is not likely to become a reality for 8 to 10 years, it is possible already now to consider establishing fundamental principles for how society can prepare itself for the future by:

- **on the one hand**, developing a financial basis for the considerable investment expenses which the publicly owned oil company Nunaoil A/S must defray in connection with the establishment of oil or gas production facilities,

- **and on the other hand**, handling the potentially considerable proceeds from exploitation of oil reserves in Greenland in a way so that the development of the oil sector is not accompanied by improper and unnecessary macro-economic structural problems.

This section describes how and under which circumstances the establishment of an oil find may support objectives above.

Chapter 5 gives an overview of the considerations regarding employment, education and supplies in connection with possible hydrocarbon activities in Greenland.

Section 5.1 An assessment is given of possible local implications for employment, education and supplies in connection with the development and operation of an oil and gas field on the Greenland continental shelf, and of how society may prepare for such development.

Section 5.2 focuses on the requirements which, in accordance with exploration and exploitation licences awarded in Greenland may and should be made to the oil companies in connection with drawing up socio-economic reports.

The analyses aim at investigating the impacts on society expected from the development and operation of specific oil and gas fields, including:

- how can we ensure that local manpower is used for most jobs, and – in line with this – what can we do to make sure that the Greenland education sector is able to meet these requirements,

- how can Greenland businesses be involved as far as possible in the operation of hydrocarbon projects.

Chapter 6 deals with the safety, health and environmental aspects of hydrocarbon activities in Greenland, including the requirements set out by the Greenland authorities in order to regulate such activities.

Chapter 7 gives a brief overview of the policy action plans which the Greenland Government has drawn up for the hydrocarbon sector.
The mineral resources activities in Greenland are managed within the framework of a special mineral resources agreement between Greenland and Denmark. The overall framework of the Mineral Resources System is set out in section 8 of the Greenland Home Rule Act, and is described in more detail in the Mineral Resources Act.

The main elements of the system are:

- Recognition of the fundamental rights of the residents of Greenland to the natural resources of Greenland.
- Shared executive powers (mutual right of veto) for the Home Rule and the State regarding principal investments and decisions relating to mineral resources.
- Distribution of public income from mineral resources activities in Greenland between the State and the Home Rule.
- A Danish-Greenland Joint Committee on Mineral Resources in Greenland, with equal representation of the two parties.

The Mineral Resources Act also lays down provisions for notification of and terms in licences for prospecting, exploration and exploitation of hydrocarbons and minerals in Greenland.

The Greenland Mineral Resources Act dates from 1991, and amendments were introduced in 1993, 1995 and 1998. The Act was drawn up after thorough analysis of the conditions regarding exploration and exploitation of mineral resources in Greenland.

The most important amendments to the Act were made in 1991, with provisions aiming at promoting interest from industry in the exploration of minerals and hydrocarbons in Greenland. Moreover, the distribution of income between the Home Rule and the State was retained at the ratio agreed in 1988 of 50:50 up to DKK 500 mill./year. This ratio still applies.

In 1993, the Mineral Resources Act was amended on one specific point: “Hydropower Resources” were deleted, and the use of hydropower became a matter for the Home Rule authorities only.

On 8 January 1998, the Greenland and the Danish Governments made an agreement on mineral resources which still applies today. Briefly, the agreement means that the Danish Government and the Greenland Government “change roles” in the administration of the Mineral Resources Act. The Greenland Government took over the Danish Government’s power to issue licences under the Mineral Resources Act. The Bureau of Minerals and Petroleum also took over the role of the former Mineral Resources Administration for Greenland in the administration of the Mineral Resources Act. Further, the Bureau of Minerals and Petroleum took over the secretariat functions for the Joint Committee. In Denmark, a state unit was established at the same time in the Danish Energy Authority, with the purpose of taking part in authority processing of cases and in servicing the Joint Committee.

2. The Mineral Resources System and the home rule process
The 1998 agreement also addressed a number of other issues, for instance the relationship of the Bureau of Minerals and Petroleum to the Geological Survey of Denmark and Greenland (GEUS), the National Environmental Research Institute (NERI), and the rights held by the Government in the management of mineral resources.


Generally, all amendments to the Mineral Resources System made since 1978 have paved the way for increasing Greenland's influence and right of decision in the area of mineral resources. However, negotiations on all amendments to the Mineral Resources System between Denmark and Greenland have been completed, and therefore, they will not jeopardize the Mineral Resources Agreement or the fundamental principles of the Home Rule Act regarding shared executive powers and the mutual right of veto, nor will they affect the distribution of income from mineral resources activities, the role of the Joint Committee, and the question of the ownership Greenland subsoil.

In 2004, the Greenland and the Danish Governments established a Greenland-Danish commission on increasing Greenland's self-government. The Home Rule Commission is to prepare a report on the possibilities for expanding the autonomy of Greenland within the Realm, based on the principle of balance between rights obligations.

The Home Rule Commission has set up two working groups: one on non-living resources, and one on economy and business development. The working group on non-living resources will consider and make proposals for future models for take-over by the Greenland authorities of matters relating to non-living resources. The terms of reference of the working groups state that the question of the relationship between possible income from mineral resources activities in Greenland and a new system for economic relations between Denmark and Greenland will be considered in the working group on economy. According to plans, the Commission will complete its work within two years.

In view of ongoing work in the Danish-Greenland Home Rule Commission, this report will not address the possible implications for society resulting from changes of the mineral resources system.
3. Oil and gas exploration in Greenland

3.1. Status of previous oil and gas exploration activities in Greenland

Exploration for hydrocarbon offshore West Greenland was initiated in the early 1970s. In the following years, five drillings were made in the areas with relatively limited sea depths. Traces of hydrocarbons were only found in the Kangaamiut-1 well.

In 1992 the Geological Survey of Greenland identified oil seeps at Disko. In the following years, seeps were also identified in a larger area, from the northern part of Disko, over Nuussuaq, and up to the southern part of the Svartenhuk peninsula. In 1996, the Canadian company GranArctic Energy Inc. carried out a drilling project at Nuussuaq, and traces of hydrocarbons were found.

In 2000, the Statoil Group carried out exploration drilling, Qulleq-1, offshore central West Greenland. Although the drilling did not reveal any deposits of hydrocarbons, the project resulted in extensive new and valuable information on the subsoil, which is essential for the organisation of exploration activities in the future.

In the period 1999–2003, the seismic industry collected extensive new seismic data from the central West Greenland offshore area with a view to sale to the oil industry in connection with the 2002 licencing round and possible subsequent rounds.
The new seismic data reveal the existence of hitherto unknown sedimentary basins offshore West Greenland. A provisional overall assessment of seismic, gravimetric, and magnetic data has outlined a large interconnected system of basins along the Ungava fault zone. The basin system may link areas with deposits of hydrocarbons offshore Labrador on the east coast of Canada to the oil seeps observed at Disko–Nuussuaq.

In 2002 a licencing round was implemented offshore West Greenland, covering the area between latitudes 63°N and 68°N. In this connection, the Canadian oil company Encana Corporation, with Nunaoil A/S as a carried partner, obtained a new exploration and exploitation licence for hydrocarbons in Greenland.

The licence covers a 3,985 km² in a sea area about 200 km northwest of Nuuk in West Greenland. In the western part of the area, the ocean depth is typically between 500 and 1,000 m, while in the eastern part it is generally between 200 and 500 m. No wells have previously been drilled in this area.
3.2. Licencing round 2004

In 2004, a licencing round was implemented offshore West Greenland, covering four licence areas, each having two or three large structures with hydrocarbon potentials.

The selection of the licence areas was based on the fact that – through analyses of all seismic data collected in the area since 1999 – the Bureau of Minerals and Petroleum and the Geological Survey of Denmark and Greenland were able to map a number of large geological structures in the region which may hold oil/gas. Of these, the most promising areas were selected for the licencing round.

In addition, the following factors were considered:

- Knowledge from other geophysical surveys, for instance gravimetric and magnetic data.
- New knowledge on for instance sedimentology, biostratigraphy and organic geochemistry etc.
- Satellite studies of naturally occurring oil seepages on the surface of the sea, which may reveal possible seepage at the sea bed.
- Mapping of areas with favourable ice conditions.

In the planning process, account was also taken of industry’s views on delimitation and timing, for instance by visits to a number of large international oil companies in Europe, and a seminar for specially invited oil companies in the spring of 2003.
As a result of these deliberations, four areas were selected for the 2004 licencing round, located off West Greenland, and covering a total area of 32,000 km² (areas 1 – 4 in Figure 2):

1. Parts of the Lady Franklin Basin between approx. 63° and 65° N, covering an area of approx. 10,500 km².
2. The Kangaamiut Basin and the ridge west of the basin, about 66°N, covering an area of approx. 4,900 km².
3. Parts of the Ikermiut fault zone/Sisimiut Basin from about 67° to 68°N, covering an area of approx. 5,600 km².
4. Parts of the Fylla area from about 63° to about 64°N, covering an area of approx. 11,200 km².
3.2. Licencing round 2004

The 2004 licensing round resulted in a new licence for exploration and exploitation of hydrocarbons in Greenland for the Canadian oil company EnCana Corporation and Nunaoil A/S. The licence covers 2,897 km² in an offshore area approx. 250 km west of Nuuk, West Greenland. Geologically, the area includes part of the Lady Franklin Basin. 4,500 km of 2D seismic data have been collected in the area. Sea depths range from approx. 750 m in the northern part to 1,750 m in the southernmost part of the licence area. No wells have previously been drilled in this area.

FIG. 3
Exploration and exploitation licences after the 2004 licencing round.
3.3. Exploration strategy

3.3.1 Choice of licencing procedure

A licencing round is a frequent and very well suited tool which is used to encourage oil companies initiate oil and gas exploration activities. The rounds procedure is used primarily in areas where the prospects of finding commercial oil or gas deposits are sufficiently large to expect several oil companies to apply for exploration licences.

By announcing a licencing round, awareness is aroused of the hydrocarbon potential in Greenland, and this may encourage some companies to assess the potential in the areas selected. In addition, announcement of a licencing round is expected to encourage the seismic industry to collect further data to be used in the oil companies’ assessment of the area. In practice, this has resulted in collection of extensive data, most recently in the summer of 2003.

An open-door procedure, where applications can be submitted on an ongoing basis, is often used in less attractive areas, where competition does not seem probable.

The open-door procedure is often most suited in areas where knowledge of the oil potential is limited, or where companies have so far not displayed any interest in commercial exploration. This might for instance be the case in areas with poor seismic data, and in areas where promising geological structures have hitherto not been found.

With a view to examining the oil industry’s assessment of the hydrocarbon potential in Greenland and the premises of the companies for implementing exploration activities in Greenland, the Bureau of Minerals and Petroleum, GEUS and Nunaoil organised a number of meetings, seminars and workshops in December 2002 and up to April 2004, meeting with a large number of European and American oil companies.

Based on these meetings with the oil industry, it was assessed that the best way of attracting the interest of industry, oil companies as well as seismic companies, would be to announce, as early as mid 2003, the intention to offer a licencing round in 2004 covering the most prospective sub-areas offshore central West Greenland, and, prior to the round, to provide the best possible data coverage of these areas.

Another aim of announcing a licencing round was to generate increased exploration and provision of new data. In connection with the announcement of licencing rounds, seismic companies are strongly encouraged to collect data in the areas covered by the future licencing. The major reason is that announcements of future licencing rounds may create market opportunities with a larger number of oil companies. In the open-door areas, the seismic companies may risk that an application is submitted for exclusive rights in an area where data have just been collected. And, thus, it would be difficult to sell data to other than the applicant.

The clear message from the authorities about organising a licensing round in 2004 did in fact cause hydrocarbon activities to reach a new peak in 2003, with the collection of 9,000 km of new seismic data in the West Greenland offshore area, and the implementation of a comprehensive and successful seabed sampling project, which, for the first time, revealed the existence of an oil-prone source rock offshore West Greenland.
3.3.2 Geological projects and marketing

A number of countries all over the world are competing to attract the attention of the oil companies. Therefore it is very important that - as a minimum - geological data and surveys are available, which illustrate and substantiate the potential of the subsoil in relation to commercialisation of hydrocarbon deposits (prospectivity).

In the past, regional mapping was typically based on publicly funded surveys. If regional data and surveys looked promising, the oil companies would naturally go on with the more specific and detailed surveys. Today, more extensive efforts from the public authorities are expected and demanded. Therefore the public sector will sometimes have to take a more proactive approach and carry out more extensive geological and geophysical surveys in order to ensure that projects mature.

The authorities therefore undertake regular projects to provide new knowledge on the mineral-resources potential of the subsoil, in order to encourage interest from private companies in exploration projects in Greenland. These projects include collection of seismic data, collection of seabed samples, airborne geophysical surveys, geological analyses and mapping, preparation of digital material, geochemical analyses from selected areas etc. The trend is, therefore, that oil companies are often fairly reluctant to invest in exploration activities in frontier areas, unless they can base their activities on publicly funded geological surveys and assessments of the oil/gas potential.

The key purpose of the projects is to be able to carry out extensive marketing efforts to promote the Greenland mineral resources potential. This is done at international trade fairs and exhibitions, by publishing newsletters targeted towards industry, by publications in international magazines, by promotion via the Internet, and by direct marketing towards selected international oil companies.

Mineral resources projects are, however, very cost-intensive – but also essential for the successful implementation of the sector policy. Therefore it is important that basic financial resources are provided on a continuous basis, enabling Greenland to retain its position as a competitive investment alternative for the international oil sector.

3.3.3 Competitive regulation

A pivotal element of the sector policy is that the conditions for obtaining an exploration and exploitation licence are set out in a model licence, prior to a new licencing round. The model licence gives industry an idea of the framework conditions for oil/gas activities in Greenland, before the licencing round is launched.

The general terms of the model licence include, for instance, the licence period, third-party activities in the licence area, regulation of technical and environmental matters, agreements on further training, procedures for approval of activities, supervision, obligations upon termination of activities, reporting, workforce and deliveries, cooperation agreement between licence holders, transfer of licences, insurance and guarantees, obligations upon termination of the licence, fiscal matters etc.

A model licence gives industry the advantage of knowing beforehand the main licence terms. Another advantage is that negotiations with applicants are limited to the terms that involve competitive parameters. The most important parameters are work programmes and the size of the licence area.
3.3.4 Prioritisation of areas in the licensing policy

The authorities update knowledge on the oil/gas exploration potential on a regular basis, partly from mineral resources projects on for instance collection of seismic data allowing assessment of the subsoil and the oil/gas potential. Such projects enable the authorities to set the order of priority of areas that are most interesting for the oil industry.

Generally, the oil industry only allocates limited funds for the assessment of the oil/gas potential in areas which – in terms of exploration – are frontier areas, such as Greenland. Therefore, in the preparation and selection of projects focusing on mineral resources, future licence areas, and future licencing, the time horizon must always be sufficient to give the oil industry enough time to include the projects in their long-term planning.

In the coming years, the operative hydrocarbon strategy will focus especially on areas which, according to surveys made so far, offer the largest oil/gas potential, and where exploration and production can be organised in an environmentally safe manner.

Areas offshore central West Greenland (63°N to 68°N)
Collection of information on almost 40,000 km seismic lines from 1999 to 2003 focused primarily on broad regional coverage of basins and structures where oil and gas may have been formed and stored, and, further, on more detailed data collection in selected areas where the oil potential seems most promising.

Large sediment basins with potential oil and gas deposits in offshore central West Greenland cover an area of more than 130,000 km². In these areas, many large well-defined structures have been mapped, which we know from experience might contain oil and gas.

The selection and delimitation of areas to be offered for exploration activities are based for instance on the following criteria:

- Building regional geological knowledge;
- Identification of large structures with a potential for oil/gas, using seismic data;
- Information from other geophysical surveys, for instance aeromagnetic and gravimetric data;
- Satellite imagery of offshore areas which can reveal possible natural oil seepage;
- Environmental aspects;
- Ice conditions and other physical framework conditions;
- Proposals from the oil industry.
3.3. Exploration strategy

The sea off Disko-Nuussuaq (68°N to 71°N)
Over the past years considerable improvements have been achieved in the data coverage of areas offshore Disko-Nuussuaq.

New geophysical data, including gravimetric and seismic data, indicate deep basins and large potential oil structures in the region near the previously mapped oil seepages on Disko Island and the Nuussuaq peninsula.

The discovery of the new very large structures offshore the natural oil seeps in the Disko-Nuussuaq area has increased industry’s interest in exploration in the area. However, there is a need for additional data to provide a sufficient basis for including the area between approx. 68°N and 71°N in a new licensing round.

According to the hydrocarbon strategy, the Greenland Government has approved an overall action plan aiming, before the end of 2006, to set out the future licensing policy for the Disko-Nuussuaq area. The licensing policy will also include selected areas in the previous licensing round region farther to the south.

FIG. 4
Status of the licencing policy.
Until then, a geological assessment will be made of the oil potential and of the conditions and terms for obtaining a licence, with a view to determining changes, where required, in the status of the area, i.e. division of the area into sub-areas planned for a) licencing rounds, b) open-door policy, and c) special procedures.

In 2005, more than 2,000 km of seismic data were collected offshore Disko-Nuussuaq. Processing of the data will be completed in early 2006, and, after interpretation and assessment, the data will be included in an overall updated assessment of the exploration potential of the area. The result of such work will be presented to the oil industry in the summer of 2006.

Southwest Greenland (south of approx. 63°N)
The data coverage of the Southwest Greenland offshore area is still fragmentary, and knowledge of the subsoil is therefore only limited. In recent years, the seismic company TGS Nopec and the Bureau of Minerals and Petroleum have collected almost 2,000 km of new seismic data in the area between 60°N and 63°N. According to these data, the sedimentary basins and structures located north of 63°N continue farther to the south, and the nature and form of the observed basins and structures indicate that oil and gas may have been generated and stored in the subsoil in this area.

However, additional knowledge is required before the area can be included in a licensing round or similar procedure. Moreover, the area is characterised by difficult operative conditions, related for instance to great sea depths and large prevalence of icebergs, and this underlines the need for collection of further seismic data with a view to minimising the risks associated with exploration to a level acceptable to the oil industry. According to plans, the area 60°N-63°N will remain an open-door area.

Other areas
As regards the areas north of 71°N offshore East and North Greenland, the nature of operational conditions is likely to prevent great interest from industry in commercial hydrocarbon exploitation in these areas in the coming years. However, the seismic data collected by a group of oil companies (known as the KANUMAS group) in the first half of the 1990s have triggered major long-term interest within the oil industry.
3.4. Action plans relating to oil and gas exploration in Greenland

**Choice of licencing procedure**

- In the course of 2005, an evaluation will be made of experience gained in the 2004 licencing round, with a view to identifying possible needs for adapting the procedure to be used in future licensing policy. As a result of this evaluation it is possible that special procedures will be introduced in the sector policy and be used in connection with open public licencing procedures.
- The result of the evaluation will be presented to the oil industry in the course of 2006, with a view to considering the views of the oil industry regarding the licensing policy.
- A policy for future licencing procedures must be agreed before the end of 2006.

**Geological projects and marketing**

- Projects must be supported and initiated, aiming at collecting new knowledge on the mineral resources potential in the subsoil. Through marketing, the projects may help increase the interest of private companies in exploration activities in Greenland. The projects should address:
  - Collection of seismic data in 2005 and in the years after, with a view to preparing a possible licencing procedure in areas that are not open for oil exploration today.
  - One of the most significant risks associated with exploration offshore West Greenland is whether the structures revealed by seismic data consist of the types of rock necessary for the formation and storage of oil and gas deposits in the subsoil. Therefore, a number of projects will be carried out in 2005 and subsequent years, documenting the presence of such rock offshore West Greenland. Among the planned activities are: taking seabed samples, analyses of natural oil seeps etc.
  - Following the licensing round in 2004, a detailed marketing plan will be drawn up in 2005, aiming at presenting the results of the mineral resources projects to selected oil companies. The marketing plan will be implemented from 2006 and onwards.
Competitive regulation

• In 2005/2006 an evaluation will be made of the terms set out in the present model licences for gas/oil activities in Greenland, with a view to ensuring that they provide a competitive regulatory framework for the oil industry, by addressing technical and environmental matters, agreements on training of staff, procedures for approval of activities, inspection, reporting, employment, choice of suppliers, transfer of licences, insurance and guarantees etc.

Prioritisation of areas in the licensing policy

• Parts of the area between 63°N and 68°N offshore central West Greenland, where data coverage and prospectivity are largest, will be evaluated with a view to inclusion in the next licensing round/special procedure.

• In the region between 68° and 71°N (Disko-Nuussuaq area), a large number of onshore oil seepages have been found, and analyses of satellite imagery suggest the occurrence of natural oil seepages on the surface of the sea. The parts of this area (onshore as well as offshore) which are shown to hold the largest prospectivity, will also be evaluated with a view to inclusion in the next licensing round/special procedure.

• An oil/gas licencing round will be prepared as an open-door procedure, or a special procedure in 2006/2007 in the areas specified above.

• According to plans, the area offshore southern West Greenland 60°N-63°N will until further notice remain an open-door area, and partly because of the very modest data coverage, and partly because of the difficult logistic conditions. In step with improved data coverage, an evaluation will be made to determine whether the area is mature and ready for inclusion in a licensing round/special procedure.
4. Economic and fiscal aspects

It is the responsibility of the authorities to design regulations for royalties and taxes, as well as other conditions for taking part in exploration and production, so that society in Greenland achieves the greatest possible benefits from the activities. Since the international oil companies possess the necessary expertise, it is important that the conditions are designed so that these companies find them competitive compared with similar areas elsewhere in the world.

When exploration is in a preliminary phase (as is the case in Greenland) the prospectivity of the area, all else being equal, will be considered extremely uncertain. With this background, it is important that private companies are given an incentive to explore in the new areas and they must be able to see a chance of reasonable financial returns if they find anything, to compensate for the significant financial risk they are accepting in the exploration. Therefore, companies balance the prospects of making a find in an area and the financial returns they could reap from such a find.

In addition to the geological and costs aspects, as well as tax and royalty conditions, the sales price of the hydrocarbons produced plays a vital role in the assessments. Oil companies have to base their decisions on expectations for changes in energy prices many years into the future, and therefore they do not base their investment calculations regarding activities in Greenland on the current high prices.

Typically, less stringent conditions are set for the first licences issued in an area, in order to provide an incentive for oil companies to make pioneer efforts. Later, the terms and conditions are tightened for new licences, if the area shows prospects (i.e. contains oil/gas in commercially viable amounts). Similarly, it is necessary to ensure that the conditions are competitive compared with other countries.

Most countries use a combination of several of the following economic instruments: corporation tax and withholding taxes, royalties on production and/or surpluses, government participation/surplus sharing/production sharing, manpower and training obligations.

Taxes are typically laid down in legislation, while other measures, for example various types of royalties, are set for each licencing round on the basis of prospectivity, logistics, and so on. Changes in the economic conditions should only take place in line with new and significant geological information which reduces the exploration risk. Moreover, stable conditions signal sincerity and credibility towards the oil industry.

On the basis of a situation where:

- the geological data in Greenland are promising, but sparse,

- there are high exploration, development and operating costs linked to sea depth, ice and oceanographic conditions etc.,

the economic conditions must be sufficiently attractive to encourage oil companies to apply for exploration licences in Greenland. It is also important that significant geological breakthroughs are made, which increase the prospectivity of an area considerably, before terms are adjusted/tightened in future licencing rounds.
4.1. Comparison of the Government take in Greenland with other countries

In 2001 the economic conditions for exploitation of oil/gas in Greenland were set on the basis of a benchmark analysis of the terms in Newfoundland, the United Kingdom (the area west of the Shetlands), the Falkland Islands and the Faeroe Islands. With the relatively modest knowledge of the oil and gas potential in Greenland at that time, the terms were set so that they were competitive compared with these comparable areas.

With these considerations in mind, before the licencing rounds in 2002 and 2004 a competitive Government-take model was established comprising:

- Corporation tax of 30%
- No royalties on revenues
- A surplus royalty of 7.5% when the internal return is more than 23.75% before tax, increasing to 17.5% and 30% when the internal return is more than 31.25% and 38.75% respectively
- A 12.5% interest for Nunaoil in the exploration phase
- Diverse taxes and charges to cover costs of processing by the authorities.

The benchmark study compares the fiscal terms applying to hydrocarbon exploration and exploitation in 15 countries. The fiscal regimes vary in the 15 countries, from highly developed oil provinces such as Norway, Great Britain and Australia, to countries that are much more in the preliminary stages of the development of a potential oil sector.

The fiscal models described in the study include two main categories:

- A category covered by a well-defined set of rules which covers all license holders (e.g. Australia and Norway), or
- A category where terms and conditions are negotiated in specific and individual agreements between the public sector and the licence holder (e.g. Mauritania, Gabon, Kazakhstan and Tunisia). In this category the licence holder negotiates the share of the production to which the state is entitled, possible state participation in the licence group, the taxes the licence holder is to pay and how such taxes are to be calculated/assessed. These contracts/agreements are generally called Production Sharing Contracts or Concessions.

In order to assess continuously the international competitiveness of the current fiscal regime compared with an assessment of the system’s ability to allow for public interests, during 2004 the Bureau of Minerals and Petroleum, in collaboration with Pricewaterhouse-Coopers (PWC), completed a new international benchmark study of the Greenland tax and royalty system (Government take), in terms of how it affects the oil industry.
In the study, the potential fiscal instruments for public revenues from oil activities comprise the following categories:

- Corporation tax and withholding tax.
- Royalty on gross revenues.
- Surplus royalty (this public revenue is calculated on the basis of the net result (revenues minus costs), and can be deducted in the tax computation. In the study, this includes Australia’s Petroleum Resource Rent Tax, and Greenland’s surplus royalty, as well as relevant Production Sharing Contracts).
- Surplus tax (this public revenue is also calculated on the basis of net result (revenues minus costs), and it cannot be deducted in the tax computation. In the study this includes Denmark’s tax on hydrocarbons and the Faeroese surplus royalty).
- Export duties/taxes.
- Other indirect taxes (such as stamp duties, value-added tax, transfer taxes, licence charges and fees etc.).
- Direct public participation in licences.

Royalties based on gross revenues are typically paid from the start of production as a fixed percentage of the value of production. Payments are thus independent of the size of the surplus from exploiting a find. The advantage of a royalty based on revenues is that the public sector receives an income from the commencement of production, irrespective of whether the oil company earns a surplus, as the royalties do not depend on the size of the surplus. The disadvantage is that the oil companies risk having to pay royalties in a situation where production has given rise to losses. Therefore, oil companies consider this type of royalty an inappropriate tax parameter and prefer other fiscal instruments.

In order to secure society a share in reasonable proportion to the revenues from any oil production, a surplus royalty can be introduced, calculated on the surplus compared with the capital invested. The advantage of surplus royalties is that the oil companies only have to pay a royalty once a reasonable internal return on the company’s investment has been achieved. In this way the oil companies can be sure that they will not have to pay a royalty on loss-making production.

A third possibility is to offer a publicly owned company a share in the licences issued. The advantage of public participation is that it allows for development of competency within the oil industry and thereby lays the foundations for a future oil industry in Greenland. In addition the public sector is assured a share of the surplus from oil production and a publicly owned company can also help increase Greenland’s share in the supply of goods and services. One of the disadvantages of demanding a publicly owned company’s participation in the exploration phase is that this increases the oil companies’ costs in this phase.

The following countries were included in the study: Argentina, Australia, Brazil, Canada - Newfoundland, Denmark (new system), Denmark (old system), the Faeroe Islands, Gabon, Greenland, Kazakhstan, Mauritania, New Zealand, Norway, Russia, Tunisia and the United Kingdom.
In the above table, royalty is calculated on the basis of gross revenues. Surplus royalty is calculated on the basis of net result (revenue minus costs), and can be deducted in the corporation tax computation. Surplus tax is also calculated on the basis of net result (revenue minus costs), but it cannot be deducted in the corporation tax computation. It should be noted that this categorisation means that the surplus royalty models for Greenland and the Faeroe Islands are each placed in their own category.
4.1. Comparison of the Government take in Greenland with other countries

4.1.2 Comparison of the Government take models

The diagrams below show revenues attributable to the licence holder (light blue) and revenues attributable to the public sector (all other colours). The first diagram assumes that no dividends are paid. The second diagram assumes dividends are paid.

FIG. 5
Division of revenues assuming no dividends paid.

Source: CIA The World Factbook
The level of revenues for the public sector (Government take) in the individual countries depends primarily on the tax rates, depreciation rules, withholding tax rules and rates, double taxation agreements and royalty/surplus royalty models and rates. Individual components are described in more detail in the sections below.

Fig. 6
Division of revenues assuming dividend paid.
4.1.3 Remarks on the sub-components in the total Government take

Corporation tax and depreciation

Even though all the countries, except Tunisia, have similar nominal corporation tax rates (24% to 35%), there is a marked difference between the effective rates. This is because of the differences in rules for depreciation. If countries allow an extra allowance on investments, e.g. in the form of an 'uplift', the effective tax rate paid will usually be lower than the nominal rate.

Countries which demand an effective corporation tax rate which is less than the nominal rate include Argentina, Australia, Greenland, Russia, Mauritania and Kazakhstan.

In this respect Greenland has rather favourable depreciation rules which limit the effective rate of taxation to 26%, significantly less than the nominal rate. The reasons for this include that:

- exploration and exploitation expenses can be deducted immediately in the year they are incurred,
- development costs and costs of investment in manufacturing plant and production equipment can be depreciated by 30% of the net value,
- Greenland allows further annual depreciation of up to 50% of the taxable income for a given year, which reduces the depreciation period. This means that, in contrast to some other countries, investment costs linked to manufacturing plant and equipment can be fully depreciated within 10 years.

Withholding tax

For all countries other than Greenland, the rate of withholding tax depends on the relevant international double taxation agreement or the relevant production sharing contract. Greenland has only entered into double taxation agreements with Denmark, Iceland and the Faeroe Islands. This report assumes that all dividends are paid to parent companies in the USA.

Withholding tax is 0% in Brazil, Denmark, Norway, Gabon, Mauritania, Tunisia, the United Kingdom, Argentina and Australia (either as a result of internal rules, specific production sharing contracts, double taxation agreements, or because there is no further tax on dividends paid after the withheld corporation tax).

Canada pays 5% (effective 2.3%), New Zealand 15% (effective 9%), Kazakhstan 5% (effective 1.6%), Russia 5 - 10% (effective 1.5%), the Faeroe Islands 20% (effective 13%).

In all countries which impose withholding tax, except Greenland and Chile, withholding tax is collected with corporation tax.

Although Greenland has the highest rate of withholding tax at 37% (in 2005) the Greenland tax system allows the dividend to be deducted from the company’s taxable income so that the maximum total tax charge cannot exceed the withholding tax.
For investors domiciled in countries where dividends are taxed, e.g. the US or the United Kingdom, a tax credit can be obtained for withholding taxes paid in countries with which they have entered into double taxation agreements. In some cases there may be problems in obtaining tax credits for withholding tax paid in Greenland, as the dividends have already been allowed for tax purposes in Greenland.

In order to improve the competitiveness of the Greenland tax system for the hydrocarbon area, it would be appropriate for the tax authorities in Greenland to initiate double taxation agreements with the US, Canada, the Netherlands, the United Kingdom, France, Italy, Germany, Australia and other countries with oil companies considering investing in mineral resources activities in Greenland (alternatively special agreements for the hydrocarbon area). Such double taxation agreements would improve investors’ possibilities to obtain tax credits in their own countries, for example on withholding taxes paid in Greenland.

Furthermore, in order to avoid erosion of the tax basis, limiting the possibilities to deduct financial costs arising from "thin capitalisation" should be considered. However, with regard to interest and transactions between associated and group companies the "arms length" principle applies in the tax legislation, and this takes account of this part of the problem.

**Royalties, surplus royalties, export duties and/or surplus tax and public participation**

Gross royalty rates for countries included in the study vary between 0-1% (e.g. Greenland – Canada) and 40% (Russia).

Surplus royalties and surplus taxes vary between 0 and 48% (Norway).

Today, traditional state participation is not utilised in very many countries (Greenland, Denmark, Norway). The main rule for public participation in the frontier countries covered by the report is that it is under production sharing contracts.

Royalties, surplus royalties, surplus taxes or a combination of these are collected in all 15 countries.

Norway, with the highest Government take, uses a combination of corporation tax, surplus tax and public participation. Other countries with a high Government take such as Gabon and Argentina use a combination of royalties, surplus royalties, production or surplus sharing, export duties and corporation tax. Countries with the highest Government take apply three or more fiscal instruments.

Apart from the Faeroe Islands and Greenland, countries with a low Government take only apply one instrument in addition to corporation tax; these are New Zealand, the United Kingdom, Canada and Australia.

New Zealand, the United Kingdom, the Faeroe Islands and Greenland collect the lowest Government take, followed by Canada, Australia and Brazil.
4.1. Comparison of the Government take in Greenland with other countries

4.1.4
Is Greenland’s Government take competitive?

A frontier country/area is one where commercially viable oil reserves have not yet been found and where production is consequently low or non-existent. Other characteristics include difficult operational conditions (because of water depths, ice conditions, remoteness from infrastructure etc.), high costs etc. When oil companies assess whether to commence activity in new areas, their considerations will also address the political stability of the area.

All else being equal, countries with significant oil production, i.e. where considerable oil reserves have been identified and where it is possible to initiate commercial production, will be able to demand the highest percentage Government take, while countries with modest or no proven reserves or production and/or difficult production conditions will usually have to accept a lower Government take, if they are to attract the oil industry.

<table>
<thead>
<tr>
<th></th>
<th>UK</th>
<th>NZ</th>
<th>FAR</th>
<th>GREE</th>
<th>CAN</th>
<th>AUS</th>
<th>BRA</th>
<th>RUS</th>
<th>TUN</th>
<th>KAZ</th>
<th>DK</th>
<th>MAU</th>
<th>ARG</th>
<th>GAB</th>
<th>NOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenues to the public sector</td>
<td>40%</td>
<td>48%</td>
<td>49%</td>
<td>51%</td>
<td>55%</td>
<td>55%</td>
<td>58%</td>
<td>58%</td>
<td>69%</td>
<td>70%</td>
<td>70%</td>
<td>71%</td>
<td>74%</td>
<td>75%</td>
<td>81%</td>
</tr>
<tr>
<td>Revenues to the licence holder</td>
<td>60%</td>
<td>52%</td>
<td>51%</td>
<td>49%</td>
<td>45%</td>
<td>45%</td>
<td>42%</td>
<td>42%</td>
<td>31%</td>
<td>30%</td>
<td>30%</td>
<td>29%</td>
<td>26%</td>
<td>25%</td>
<td>19%</td>
</tr>
<tr>
<td>Production (Mbbl/day)</td>
<td>2.5</td>
<td>0.04</td>
<td>0</td>
<td>0</td>
<td>2.7</td>
<td>0.7</td>
<td>1.6</td>
<td>7.2</td>
<td>0.07</td>
<td>0.8</td>
<td>0.3</td>
<td>0</td>
<td>0.8</td>
<td>0.3</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Tabel 2
Hydrocarbon production by country.

On the basis of the criteria for the existence of considerable proven oil reserves and the production in progress, countries such as Russia, Canada, the United Kingdom, Kazakhstan, and Norway will be considered well-established non-frontier countries.

On the basis of the criteria for low or no production, New Zealand, the Faeroe Islands, Greenland and Mauritania can be described as frontier countries. Therefore, it is important that, as a minimum, Greenland has a competitive level of Government take compared with these countries.

Between these two groups are countries such as Brazil and eastern Canada (both of which have significant production), and Denmark, Australia and Argentina (which to a certain extent have difficult operational conditions). It can be argued that certain countries in this group belong to one of the other groups.

When withholding tax is included in the comparison of the fiscal levels of the various countries, Greenland is higher than New Zealand and the Faeroe Islands, but lower than Mauritania. Greenland’s most obvious rival here is the Faeroe Islands.
Therefore, there does not seem to be reason for increasing the total level of Government take, in comparison with the level of the Faeroe Islands.

Compared with other countries with an extensive oil sector, Greenland’s level of Government take is generally lower. However, this does not apply with respect to the United Kingdom, where the Government take is lower than Greenland. Overall, therefore, Greenland seems to have a suitable level of taxes, surplus royalty, duties, and participation by public-sector oil companies in comparison with other countries. In accordance with the overall principles of competitiveness, a change in the current level would require a significant break-through in geological knowledge, which greatly increases prospectivity.

4.1.5 Possible future royalty models

As Greenland must still be considered a frontier country for oil exploration, it is important that any new royalty models are competitive with regard to both well-established oil-producing countries and other frontier countries.

The advantage of the current surplus royalty in Greenland is that society’s share is reasonable in relation to income from possible oil production. Another advantage is that the system is not prohibitive to investment, as oil companies only have to pay royalties on surpluses once they have earned a reasonable internal return on their investment (i.e. an appropriate surplus in relation to the very large initial investments linked to oil exploitation). In this way oil companies can be sure that they will not have to pay royalties on loss-making production. In contrast, collection of a traditional revenue-based royalty would be inappropriate as it would mean that the highest percentage Government take is demanded for a low surplus and thus the system would inhibit investment by the oil industry.

Retaining a surplus royalty keeps to the principle that production tax should only be paid if a surplus is earned under a licence. In comparison, in the Danish part of the North Sea, licence holders have so far had to pay a royalty calculated on the basis of revenue. In 2004, this royalty was replaced with tighter taxation of hydrocarbons, also based on a surplus principle.

Naturally, the result of a surplus-dependent system is that the greater the investment in developing a production field, the less the income for the Home Rule from the surplus royalty. The reason for this is that the oil companies do not have to pay the surplus royalty until they have a surplus which covers the investment and operating costs incurred as well as interest on the capital invested.

From the public sector’s perspective, the worst possible scenario would be a licence with exceptionally high initial investment over a large number of years before production commences. In this case the surplus royalty could be reduced considerably. On the other hand the licence holder would have funds tied up in the investment for many years without earning a return to cover the costs of financing the investment. All else being equal, this would reduce the licence holder’s real return from the licence, and therefore it is in the licence holder’s interests to start production as quickly as possible.

The action plan adopted for continuing the hydrocarbon strategy aims at describing in more detail selected areas in the Disko-Nuussuaq region for example, and it is based on new geophysical data, including gravimetric and seismic data, which indicate deep basins and very large potential oil structures in the region close to the previously mapped oil seeps on Disko island and on the Nuussuaq peninsula.
The Disko-Nuussuaq region is also characterised by difficult operating conditions, not least sea ice and icebergs, and this means that initial investments in oil-extraction equipment will probably be much higher than for the seas further south. The high level of investment (with the current surplus royalty system adapted to areas further south) could reduce the percentage share of the public sector in the oil companies’ surplus to an inappropriately low level.

The Greenland Government is therefore considering introducing an adapted royalty system which retains the best elements of the current system, but which is also less sensitive to the large initial investment. In this context it is important that the system is not designed so that it inhibits investment by the oil industry.

The primary objective of an adapted system is that it should be less sensitive to large initial investments and adapted to a frontier area, i.e. that it should only add limited supplementary revenue to the corporation tax if the oil companies’ only earn modest returns from activities in Greenland. However, the system should also be progressive so that the industry pays a higher percentage Government take to the public sector if the surplus from oil activities rises. At the same time the model must be suitably simple and transparent for the oil industry.

To help in this assessment, the Bureau of Minerals and Petroleum, in collaboration with PWC, has analysed a number of alternative models of royalty and surplus royalty collection. The models have been set up with inspiration from the economic models known from other countries, and they have been designed and assessed by the Bureau of Minerals and Petroleum in an iterative process in which PWC has been asked to calculate the consequences and comment on the models. The models included in the analysis below only cover some of the models that were analysed.

Models which, using control calculations, have been characterised as being either (a) extremely inhibitive to investment – i.e. even more than some of those shown, (b) special examples for some of the models included or (c) very degressive – i.e. with an increasing tax rate for falling surplus and vice-versa, have not been included in the final presentation. The following models are compared in this analysis:
• **Model 1:** The current Greenland model – which is that surplus royalties of 7.5%, 10% and 12.5% are demanded when the company’s internal return exceeds respectively 23.75%, 31.25% and 38.75% (i.e. the different rates for surplus royalties are triggered when the company achieves specific levels of return on the investments made).

• **Model 2:** Modified Greenland model 2 – which is that surplus royalties of 5%, 7.5% and 13% are demanded when the company’s internal return exceeds respectively 15%, 19.5% and 37%.

• **Model 3:** Modified Greenland model 3 – which is that the current Greenland model is restricted so that the return on the capital invested can only be deducted from the income basis for a limited number of years:
  - 4 years’ right to deduct interest when surplus royalty of 7.5% is demanded
  - 5 years’ right to deduct interest when surplus royalty of 10% is demanded
  - 6 years’ right to deduct interest when surplus royalty of 12.5% is demanded

• **Model 4:** Modified Greenland model 4 – which is that the current Greenland model is restricted so that there is a ceiling on the deduction for return on the capital invested in the income basis:
  - Max. deductible interest of 40% of the investment when surplus royalty of 7.5% is paid
  - Max. deductible interest of 60% of the investment when surplus royalty of 10% is paid
  - Max. deductible interest of 100% of the investment when surplus royalty of 12.5% is paid

• **Model 5:** Combination of models 3 and 4, i.e. terms of years and percentage limits for deduction of interest on the capital invested.

• **Model 6:** A model inspired by Mauritania – i.e. a surplus royalty model based on number of barrels of oil produced per day:

<table>
<thead>
<tr>
<th>Barrels per day</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 50,000</td>
<td>10%</td>
</tr>
<tr>
<td>Between 50,000 and 100,000</td>
<td>15%</td>
</tr>
<tr>
<td>Between 100,000 and 150,000</td>
<td>20%</td>
</tr>
<tr>
<td>More than 150,000</td>
<td>25%</td>
</tr>
</tbody>
</table>

• **Model 7:** A model inspired by Tunisia – i.e. a model involving addressing the relationship between accumulated revenues and accumulated expenses (R = acc. rev. / acc. exp.).

<table>
<thead>
<tr>
<th>R</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 0.5</td>
<td>2%</td>
</tr>
<tr>
<td>From 0.5 to 0.8</td>
<td>5%</td>
</tr>
<tr>
<td>From 0.8 to 1.1</td>
<td>7%</td>
</tr>
<tr>
<td>From 1.1 to 1.5</td>
<td>10%</td>
</tr>
<tr>
<td>From 1.5 to 2</td>
<td>12%</td>
</tr>
<tr>
<td>From 2 to 2.5</td>
<td>14%</td>
</tr>
<tr>
<td>More than 2.5</td>
<td>15%</td>
</tr>
</tbody>
</table>

• **Model 8:** A progressive model inspired by New Zealand – i.e. a model involving collecting surplus royalties of 20% when accumulated revenues exceed accumulated expenses by 20%.

• **Model 9:** An extended progressive model inspired by New Zealand – i.e. a model involving collecting a surplus royalty of, e.g. 8%, 10%, 15% and 20% when accumulated revenues exceed accumulated expenses by 30%, 35%, 65% and 75% respectively.
4.1. Comparison of the Government take in Greenland with other countries

The diagram below shows the percentage revenue to the public sector for each of the nine models mentioned above. The diagram also includes the results of sensitivity calculations which show the changes in Government take rates compared with the current Greenland model for taxes and surplus royalties etc., when the sales price for a barrel of oil is increased or reduced by USD 10 and when expenses are increased by 30% or reduced by 20%.

I.e. the following assumptions:

- Sales price per barrel oil - USD 30
- Sales price per barrel oil - USD 20 (Base Case)
- Sales price per barrel oil - USD 10
- Increase of 30% in exploration, investment and operating costs
- Reduction of 20% in exploration, investment and operating costs

FIG. 7
Government take for different royalty models.
Models 2 – 5 are all variants of the current Greenland model (Model 1). The current Greenland model includes a progressive Government take, so that the public share of the surplus increases when the surplus from oil activities increases. However, the model is also sensitive to increasing investment costs.

Models 2 – 5 all increase Government take considerably compared with the current model when the costs of an oil activity rise. So, these models make Government take less sensitive to higher initial investments, but they still make Greenland less competitive compared with competing countries such as the Faeroe Islands, New Zealand and Mauritania in situations where oil activity is less profitable because of lower oil prices.

If one of these models is to be assessed in more detail, model 2 is the closest to the goals of a) less sensitivity to initial investments; b) increasing Government take with increasing surplus; and c) competitive compared with other countries. However, model 2 has the disadvantage compared with the current model with its more limited progressivity at very high surpluses.

Models 6 and 7 do not demonstrate the required progressivity, on the contrary they are degressive at low surpluses, i.e. the rate of Government take increases as surplus falls. Neither do the models expand the required progressivity at high surpluses.

Model 8 has the required progressivity, but there are no further increases in the rates of Government take at very large surpluses.

Model 9 seems to demonstrate the best functionality under the required criteria. The model meets the progressivity requirements and the rate of Government take increases reasonably at high surpluses.

In connection with the planned preparation of the Disko-Nuussuaq area for issuing new oil licences, the most competitive Government-take models will either be the current model, model 2 or model 9. The final model will be set on the basis of the geological surveys etc. currently being carried out for the future licencing policy in the area.
4.2. Public-sector revenues

In accordance with the hydrocarbon strategy, in 2004 a new licencing round was carried out covering four marine areas between 62°N and 68°N off the coast of West Greenland (see Figure below).

The four licence areas were selected so that each contains at least two or three large structures with potential for deposits of oil or gas. This was done on the basis of an analysis of all the seismic data so far gathered in the area. The analysis led to the Bureau of Minerals and Petroleum and the Geological Survey of Denmark and Greenland mapping a significant number of large geological structures in the region, of which the most promising were selected (“the Mammoth Project”).

The operational conditions in the area are characterised by sea depths of between 200 and 1,500 meters. For some of the year activity will also be affected by sea ice and icebergs. Sea-ice cover in May 2003 and the general drift patterns for the ice field are described in the Figures below:

Sea-ice May 2003
(max spread February – April/May)

Drift patterns for the ice field

FIG. 8
Ice conditions offshore West Greenland.
This section has included calculations of the revenues, which under certain assumptions could accrue to the public sector from the exploitation of an oil field located in one of the structures in the subsoil mapped on the basis of the seismic data prior to the licencing round in 2004. The calculations are based on the production and costs data estimated by Nunaoil.

The field could be developed using specially built floating production equipment with storage facilities and able to load tankers without leaving the production site (an FPSO facility). Furthermore it is possible to inject water and gas into the reservoir. Production and injection wells are linked to the production vessel.

The costs of production also depend on the geological properties of the layers containing the hydrocarbon deposits. In certain situations, exploitation will require a large number of production wells, while the oil structures located in layers with other geological characteristics could produce using fewer wells. If exploitation requires a large number of wells, the total costs, not least investment costs, will be correspondingly high.

In addition to the cost and geological aspects, the price of oil is central to assessments of the accumulated results of an oil activity. An oil field will often be able to produce hydrocarbons for 30 – 50 years. As can be seen from the graphs below, oil prices in just the years 1998-2004 fluctuated between USD10 and USD50 per barrel oil.
4.2. Public-sector revenues

These calculations are on the basis of the assumption below for production and costs.

- Investment costs of USD 2.82 per barrel oil
- Exploration costs of totalling USD 226 mill.
- Decommissioning costs of USD 256 mill.
- Operating costs of 21% of total gross revenues
- Transport costs of USD 1 per barrel oil
- Production period of 50 years
- Production of 2 bn. barrels oil

The financial assumptions are as follows:

- Oil price throughout the production period of USD 20 per barrel oil
- Corporation tax rate of 30%
- Surplus royalty calculated under the current rules with three rates of 7.5% / 10.0% / 12.5% with an uplift of 21.75% / 29.25% / 36.75% respectively and a discount rate of 2%

FIG. 10

So, there is a number of factors which add to the uncertainty of the financial result of exploiting a field of a given size. This also means that the public-sector share of the surplus could vary considerably.
On the basis of the assumptions above, the Bureau of Minerals and Petroleum and PWC have calculated the following result:

<table>
<thead>
<tr>
<th>Licence holders excl. Nunaoil</th>
<th>Nunaoil 12.50%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue from sale of oil</strong></td>
<td>34,465.03</td>
<td>4,923.58</td>
</tr>
<tr>
<td><strong>Transport costs</strong></td>
<td>-1,723.25</td>
<td>-246.18</td>
</tr>
<tr>
<td><strong>Exploration</strong></td>
<td>-226.19</td>
<td></td>
</tr>
<tr>
<td><strong>Investments</strong></td>
<td>4,861.39</td>
<td>-694.48</td>
</tr>
<tr>
<td><strong>Decommissioning</strong></td>
<td>-224.31</td>
<td>-32.04</td>
</tr>
<tr>
<td><strong>Operating costs</strong></td>
<td>-7,247.08</td>
<td>-1,035.30</td>
</tr>
<tr>
<td><strong>Profit before tax</strong></td>
<td>20,182.81</td>
<td>2,915.57</td>
</tr>
<tr>
<td><strong>Corporation tax</strong></td>
<td>-4,762.95</td>
<td>-680.42</td>
</tr>
<tr>
<td><strong>Surplus royalty 1</strong></td>
<td>-1,470.02</td>
<td>-210.00</td>
</tr>
<tr>
<td><strong>Surplus royalty 2</strong></td>
<td>-1,637.62</td>
<td>-233.95</td>
</tr>
<tr>
<td><strong>Surplus royalty 3</strong></td>
<td>-1,329.86</td>
<td>-189.98</td>
</tr>
<tr>
<td><strong>Net profit</strong></td>
<td>10,982.36</td>
<td>1,601.22</td>
</tr>
<tr>
<td>Licence holder’s share as % of total profit before tax</td>
<td>47.50%</td>
<td></td>
</tr>
<tr>
<td><strong>Total taxes, surplus royalty and Nunaoil</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corporation tax</td>
<td></td>
<td>5,443.37</td>
</tr>
<tr>
<td>Surplus royalty</td>
<td></td>
<td>5,071.44</td>
</tr>
<tr>
<td>Nunaoil</td>
<td></td>
<td>1,601.22</td>
</tr>
<tr>
<td><strong>Total taxes, surplus royalty and Nunaoil as % of total profit before tax</strong></td>
<td></td>
<td>52.50%</td>
</tr>
</tbody>
</table>

Tabel 3
Financial result from exploitation of the model oil field.

Under the assumptions stated above, the total proceeds for the public sector, including the 12.5% share for Nunaoil and taxes and royalties over the entire period of production amount to USD 12.1 bn. This corresponds to 52.5 per cent of the total surplus of the project.

It is clear that there can be considerable revenues for the public sector, provided the structures observed in the seismic data gathered in recent years from the sea off West Greenland contain oil and/or gas. However, it is also important to stress that the level of potential revenues depends very much on a number of external factors linked to the depth of the sea, ice conditions, geological characteristics, oil prices, etc.

Potential public-sector revenues may, however, be so large that it is important to have a clear policy for managing such revenues in society. The section below includes a proposal for a long-term policy to manage these funds.
4.3. Financial plan and management of the public-sector revenues from oil and gas activities

Development of a hydrocarbon industry could have significant effects on the economy because of the higher income to society.

This higher income will often be able to finance growth in public expenditure with the consequential welfare benefits such as better public services in the housing, health and family/social fields. The additional revenues could also help improve the long-term framework of the economy by increasing focus on education and research as well as investing in improving and modernising the infrastructure for traffic, harbours, energy, structural reorganisation etc.

The greater activity and revenues will also, however, have an unintentional negative impact on the competitiveness of other businesses so that these sectors will not be competitive internationally when the hydrocarbon activities near termination.

The problem could be that hydrocarbon activity and the public income arising from this cause an inflationary pressure on salaries and prices, with a consequential reduction in competitiveness and thus falling investment and employment in other sectors than the hydrocarbon industry.

This negative impact on long-term competitiveness is often referred to as "the Dutch disease", as the problem was first observed in connection with large Dutch finds of natural gas in the late 1950s.

The long-term economic effects of hydrocarbon activity therefore greatly depend on how the increased revenues are managed.

Management of the higher public revenues from exploitation of mineral resources should be considered on the basis of a limited normal exploitation period (25 – 50 years for an individual deposit) and that the period over which taxes and duties accrue to the public sector will be even shorter. For extraction of hydrocarbons from a single find in particular, the period in which very high revenues are received will be very limited.

A crucial element in the economic policy should therefore be to manage the revenues from hydrocarbon activities so that, as far as possible, society avoids impacts similar to the Dutch disease, i.e. implement economic policies which prevent inflation and rising costs.

If the current hydrocarbon exploration at some time leads to development of a hydrocarbon industry in Greenland, the economic policy should be organised so that society achieves sustainable and positive economic development.
Important elements in such a policy could be:

• To ensure development of a long-term sustainable economy.

• As the foundation for this, to invest in long-term development of a framework for the economy including focus on education and research, investments in improving and modernising the infrastructure, structural reorganisation, and business development.

• To save funds to secure welfare schemes for future generations in the event that the economy is exposed to significant cyclical fluctuations, for example the Faeroe Islands’ economic problems in the early 1990s.

• This should not, however, be confused with an “economic-cycle stabilisation fund”, which could be used to finance social activities in periods of low economic growth or to absorb revenues from tax packages introduced to cool down the economy in periods where it threatens to overheat. The effect of such an economic policy would probably be limited in a small and open economy such as that in Greenland.

• To ensure that revenues from hydrocarbon activities are managed so that, as far as possible, society avoids impacts similar to the Dutch disease, i.e. implement economic policies which prevent inflation and rising costs.

With this background, the Greenland Government intends to consider the advantages and disadvantages of establishing a hydrocarbon fund to manage the public-sector revenues from possible future hydrocarbon production. The purpose of such a fund will be to receive revenues from hydrocarbons and transfer them to the Landskassen (the Greenland treasury) in accordance with agreed long-term economic and economic policy targets. An example of this is experience from Norway, where the Petroleum Fund was set up in the early 1990s with a similar objective.

Although revenues from hydrocarbon activities will not flow to the fund for some years, it may be appropriate to introduce legislation for a fund now. This would make it possible to commence transfer of funds to the fund now. If significant finds of hydrocarbons are made, the Home Rule, via the publicly owned oil company Nunaol A/S, will have considerable net financing needs to invest in production equipment in the first years until income is generated. If funds have been saved up in the fund, it will be possible to reduce the future budget deficit in the annual Finance Act and public sector indebtedness by a corresponding amount.

It has been estimated that the total capital costs to bring an oil field in Greenland online could be about DKK 15-20 bn. In current licences Nunaol A/S has a 12.5 per cent share, which means that the oil company would have to be in a position to contribute DKK 1.9 – 2.5 bn. per oil field to retain the 12.5 per cent ownership share. With the current ownership structure of Nunaol A/S, the Home Rule would have to provide 50 per cent of the company’s financing needs, i.e. about DKK 1 to 1.3 bn. per oil field.

On the basis of oil companies’ activities within the framework of the two existing exploration and exploitation licences, as well as general interest from the oil industry measured from purchases of seismic data from offshore West Greenland, it is possible that one or more oil fields will start producing in the next ten years. Therefore, as part of economic policy priorities, inclusion of a target surplus of DKK 200 mill. per year in the Finance Act should be considered. This surplus should then be transferred to the hydrocarbon fund in order to make available a financing foundation for a publicly owned oil company’s investment needs in the event that commercial finds of hydrocarbons are made in Greenland.
4.3.1 Establishment of a hydrocarbon fund

A fund requires separate treatment of hydrocarbon revenues by taking them out of the Finance Act and posting them to the fund.

Establishment of a hydrocarbon fund secures a buffer against fluctuating revenues from hydrocarbon production.

Hydrocarbon revenues are not income in the traditional sense. Hydrocarbon revenues arise from "tapping" the national wealth; the hydrocarbons in Greenland’s (marine) territory. If the national wealth is not to be reduced, hydrocarbon revenues must be spent on developing other parts of the national wealth.

The hydrocarbon fund also helps balance the economy by distributing the wealth between generations. Even though the hydrocarbon asset is reduced, the returns from the funds invested would benefit many generations in the future.

The hydrocarbon fund could be Greenland Home Rule’s instrument to move wealth from oil and gas reserves to a wide portfolio of international securities.

4.3.2 Fund revenues

Revenues to the fund will be net cash inflows from hydrocarbon activities and interest income/returns on the fund’s future assets. The net cash flows will be the sum of:

- Total direct taxes and royalties paid by licence holders on hydrocarbon activities in accordance with legislation.
- Revenues arising from Greenland Home Rule’s direct financial involvement in hydrocarbon activities, defined as operating revenue and other revenue less operating costs and other direct expenses.
- Revenues to the Greenland Home Rule from any net surplus agreements in individual drilling licences.
- Dividends from Greenland Home Rule’s holdings in hydrocarbon companies (currently the 50 per cent of the oil company Nunaoil A/S).
- Greenland Home Rule’s income from removing or disposing of installations.
- Possible sales by the Greenland Home Rule of parts of its direct financial interests in hydrocarbon activities.
- Capital injections into hydrocarbon companies fully or partly owned by the Greenland Home Rule.
- Direct investments by the Greenland Home rule in hydrocarbon activities.
- Costs incurred by the Greenland Home Rule in connection with removing or disposing of installations.
- Any purchases by the Greenland Home Rule of holdings as part of the direct investments by the Greenland Home Rule in hydrocarbon activities.
4.3.3 Procedure for utilising funds from the hydrocarbon fund

The part of the hydrocarbon revenues to be spent is transferred to the Home Rule treasury and included as income in the Finance Act.

Guidelines for the annual transfers from the fund to the Home Rule are very important for the proposed economic policy control system. All the budgets for administrative units and general fiscal policy must be adapted within this system.

The Home Rule must take the following approach in setting transfers from the hydrocarbon fund:

- General long-term guidelines for the size of the transfers from the hydrocarbon fund to the Home Rule should be written into the Greenland Home Rule programme for long-term (minimum 10 years) economic and economic policy and forecasts. These guidelines must also be taken into account in long-term assessment of the expected changes in revenues from hydrocarbons.

- Regular transfers from the hydrocarbon fund should be reviewed each year in connection with preparation of the following year’s budget/Finance Act for the Home Rule. In each case it must be decided how specific such a review should be. There should be comparisons with the assumptions/requirements of the long-term planning.

There should be controls so that democratic management of economic policy is not compromised or made more complex by using funds from the hydrocarbon fund for purposes outside the Finance Act.

4.3.4 Build up of the fund

The fund will increase when the net cash inflows exceed transfers from the fund in the Finance Act, and it will fall when net cash inflows are less than transfers. The current high oil prices and the proposed tax system mean that commencement of hydrocarbon production would give rise to a positive build up in the fund in the long term. There will be a period of investment before the production period when, via its holding in an oil company, the Home Rule will have to inject considerable sums into these investments. With this background it could be advisable to begin building up the fund now through allocations from the Finance Act so that it is ready to finance these investments. If this does not happen, the Home Rule will probably have to finance the investment through loans for a certain period.

4.3.5 Placement and utilisation of funds from the hydrocarbon fund

Geographic exposure

The capital accumulated in the hydrocarbon fund should all be placed outside Greenland.

If part of the capital of the hydrocarbon fund is invested in the domestic economy, in reality it will merely comprise a "Finance Act no. 2" to meet purposes which have not been dealt with/financed by the Finance Act itself. This would undermine the priorities adopted in the Finance Act. Placing the funds domestically in Greenland outside the Finance Act would exacerbate the risk of Dutch disease in the Greenland economy. One of the primary objectives of the fund was to avoid such undesirable impacts on the domestic economic structures.
Another reason to place the funds of the hydrocarbon fund outside Greenland is that this will make it possible to reduce the risk of the fund by spreading the investments in different countries and regions throughout the world. There is also reason to believe that the returns from the fund will be considerably lower if the fund only invests in the limited Greenland economy. This is clearly also because the fund will probably be so large that projects of sufficient size and return simply do not exist in Greenland.

Finally, Greenland society will usually use the accumulated surplus to buy more goods and services from abroad (increased imports). Therefore it is clear that management of the fund should seek to ensure appropriate development of the fund’s international purchasing power. This is also the reason for placing less emphasis on the impact of any changes in the DKK exchange rate on the returns to the fund. Such changes would not influence the fund’s purchasing power.

**Choice of manager**
The hydrocarbon fund will be managed in its own name by an institutional manager within the Kingdom of Denmark. The institution should have a high degree of expertise in investment management as well as adequate ethical guidelines. An institutional manager means a pension fund or an asset management company subject to supervision by a supervisory authority within the EU.

**Composition of the portfolio and investment limits etc.**
In connection with the possible presentation of a bill, proposals should be presented on detailed regulations and guidelines (statutory order) for managing the fund. These regulations should describe the overall guidelines for management, including regulations for the overall composition of the portfolio, investment limits etc.

A key issue regarding placement would seem to be assessment of an appropriate size of holdings in equities. Danish pension funds have generally reduced their shareholdings in recent years, probably because of the fluctuating returns and a desire to reduce the risk profile of the investment portfolio. It should be mentioned in this regard that certain Danish insurance companies with significant shareholdings experienced financial difficulties following the collapse in stock markets after 11 September 2001. The hydrocarbon fund will not have financial obligations which can lead to bankruptcy or similar from price fluctuations in the short term, in the same way as pension companies. Therefore the fund can set a more long-term strategy than pension funds. However, it is important to consider very closely how far the fund is willing to accept a risk of fluctuations and losses of some of its wealth in the expectation of better long-term returns on investments in equities compared with safer investments in interest-bearing securities.

Another point worth mentioning here is that after 1997 the Norwegian Petroleum Fund no longer had to place all its funds in interest-bearing securities as its instructions were changed so that 30-50% of the portfolio had to be invested in equities. For some years the Fund recorded losses on equities, while the returns on interest-bearing securities remained positive. This meant that an overall deficit for 2001 and 2002, and according to the table below (source: Norges Bank website) the returns for the period 1997-2003 have been lower on equities than on interest-bearing securities.
Tabel 4  
Annual nominal and real returns for the Petroleum Fund 1997-2003 in percent, calculated against the Fund’s basket of currencies.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal return</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-on equity portfolio *</td>
<td>-</td>
<td>12.86</td>
<td>34.81</td>
<td>-5.82</td>
<td>-14.59</td>
<td>-24.37</td>
<td>22.83</td>
<td>2.16</td>
</tr>
<tr>
<td>-on interest portfolio</td>
<td>9.07</td>
<td>9.31</td>
<td>-0.99</td>
<td>8.41</td>
<td>5.04</td>
<td>9.90</td>
<td>5.26</td>
<td>6.51</td>
</tr>
<tr>
<td>-on total portfolio</td>
<td>9.07</td>
<td>9.25</td>
<td>12.44</td>
<td>2.50</td>
<td>-2.47</td>
<td>-4.74</td>
<td>12.59</td>
<td>5.31</td>
</tr>
<tr>
<td>**Price increases **</td>
<td>1.75</td>
<td>0.92</td>
<td>1.28</td>
<td>2.02</td>
<td>1.18</td>
<td>1.89</td>
<td>1.36</td>
<td>1.49</td>
</tr>
<tr>
<td><strong>Real return</strong></td>
<td>7.19</td>
<td>8.25</td>
<td>11.02</td>
<td>0.47</td>
<td>-3.61</td>
<td>-6.51</td>
<td>11.08</td>
<td>3.77</td>
</tr>
<tr>
<td>**Costs of management ***</td>
<td>0.04</td>
<td>0.06</td>
<td>0.09</td>
<td>0.11</td>
<td>0.07</td>
<td>0.09</td>
<td>0.10</td>
<td>0.08</td>
</tr>
<tr>
<td><strong>Net real return</strong></td>
<td>7.15</td>
<td>8.19</td>
<td>10.93</td>
<td>0.36</td>
<td>-3.68</td>
<td>-6.60</td>
<td>10.98</td>
<td>3.69</td>
</tr>
</tbody>
</table>

* Including the separate Miljøfondet (Environment Fund)  
** Average consumer price increase in the countries included in the Fund’s reference portfolio for the relevant year  
*** Costs include remuneration for external managers for additional returns. Costs for 1997 are estimated.

It should also be noted that the reasons for increasing the proportion of equities in the Norwegian Petroleum Fund mentioned that it should be seen in the context of the fact that the revenues were larger than originally estimated and therefore a longer investment horizon was set for management of the funds than previously.

This may indicate that it may be advisable to await developments in revenues for the Greenland hydrocarbon fund before finally deciding on an appropriate proportion of equities.

A risk-averse investment strategy is proposed where certainty that there is no deterioration in value has higher priority than the possibility of earning a higher return through investing in equities. In this connection it is considered that the objective of the fund is not to take investment risks in the hope of high investment returns, but to secure the purchasing power of the savings in the Fund.

It is proposed that the investment regulations be set in a separate statutory order or act in order to ensure broad agreement on this point.
Further to the benchmark study of the international competitiveness of the current fiscal regime presented in this report, regular evaluation of the fiscal conditions for exploitation of oil and gas should be carried out so that the Government takes always reflects the prospectivity of the individual regions.

In connection with the planned preparation of the Disko-Nuussuaq area for issuing new oil and gas licences, the final model for royalties and surplus royalties will be set by the Greenland Government and the State following relevant negotiations in the Joint Committee on Mineral Resources in Greenland. The basis for the models will be:

- partly partly the result of the geological surveys etc. currently being carried out in the area as preparation for the forthcoming licensing round for the area, and

- partly the most competitive models described in the section “Possible future royalty models”, i.e. the current Greenland model, model 2 or model 9.

Up to EM 2005, the Greenland Government will consider the advantages and disadvantages of setting up a hydrocarbon fund with the objectives:

- partly to establish a financial foundation for the considerable investment costs the publicly owned oil company Nunaol A/S will incur in connection with establishment of oil or gas production facilities, and

- partly to manage the potentially considerable revenues from exploiting oil reserves in Greenland so that the development of the oil sector does not lead to undesirable and unnecessary structural problems for the Greenland economy.

The considerations will be made within the framework of the overall priorities for expenditure in connection with the design of the economic policy for the coming years.
5. Employment, education and commercial aspects

5.1. Manpower, educational requirements and supplies in a potential Greenland oil industry

Oil or gas production require a very long and expensive exploration process, where the authorities offer licences to interested oil companies, often in return for completing a relevant work programme for the licence. At best, the oil companies find hydrocarbon deposits which are deemed financially viable, after which the licence is extended and production initiated.

A typical process for hydrocarbon-producing countries is as follows:

- Firstly an appropriate structure is established for managing and developing an oil industry in the country. The workforce for this phase typically includes some generalists, as well as technical scientists and consultants, including several with expertise and experience from similar projects in other countries.

- Next, the area is marketed to oil companies with a view to encouraging them to apply for exploration licences from the authorities. During this phase, exploration-relevant surveys are initiated, including data collection, and the necessary manpower typically includes specialists and commercial firms for the individual projects.

- If there is a basis for actual oil exploration in the area, the authorities hold a licencing round or use other methods to grant exploration licences. Success in finding takers for licences partly depends on how attractive the area is in terms of geological, climate and logistical conditions, the level of taxes and duties, costs of development and production, as well as oil prices. If a large number of applications for licences are received, there is a basis to recruit more technicians and case officers to carry out authority work, as exploration licences typically run over many separate phases for many years. Competence development and local supplies will primarily be the responsibility of the authorities for this type of work.
5.1. Employment, education and commercial aspects

- When a licence is granted, the licence holder will complete the work programme for the licence. The work programme is divided into phases so that the licence holder can return the licence once the individual phases have been completed, if the licence is not deemed attractive enough for further work. The final part of the work programme is usually exploratory drillings to confirm hydrocarbon deposits. These drillings typically last for 2-3 months and will mean that the local labour market experiences short-term effects from increased demand for sailors, divers, harbour and logistics personnel, hotel and catering staff, pilots, steward(esse)s, airport personnel etc.

- Assuming the licence holders find hydrocarbons in test drillings, there will be a commercial evaluation of the specific find. If the find is deemed commercially viable, there will be a decision regarding extending the licence, or the licence will be returned. If a licence in Greenland is extended, this will create a large number of different local jobs, although most of the production equipment will have to be manufactured at companies/shipyards with special expertise and considerable experience. In Greenland there will particularly be a need for sailors, divers, metal workers, electricians, harbour and logistics personnel, IT specialists, hotel and catering staff, engineers, geologists, office staff, builders, pilots, steward(esse)s, airport personnel etc. In this phase of the oil industry’s development there is a good basis for starting actual competence development in Greenland.

- After developing the first finds, it is likely that more commercial finds will be made and these will be developed. In time, the oil industry in Greenland will mature and the local workforce will develop competences which the oil industry can use internationally. However, it is important to note that throughout the world the oil industry is characterised by a very international working environment, where highly qualified manpower is used without taking account of its country of origin.

- When, after some years, an oil field is "empty", it must be left. The first finds for development in Greenland will be of such a size that decommissioning will not commence until after several decades’ production.
The phases of hydrocarbon production are summarised in the figure below.

![Diagram of hydrocarbon production phases](image)

**FIG. 11**
Chronology of hydrocarbon production.

The time horizon in oil exploration should be noted. From granting a licence after a licencing round to a positive commercial evaluation of the licence, if the process gets that far, can easily take a decade. After this development commences and at best this will take a further 2-3 years.

### 5.1.1 Supplies for the oil industry

Supplies for the oil industry in Greenland, in which Greenland businesses can expect extensive involvement, can be divided into two categories:

- The development phase
- The operating phase

In addition there will probably be increasing local involvement in development and later operation of a hydrocarbon find, as, in time, competence development will take place automatically which makes Greenland manpower attractive to the oil industry.

### 5.1.2 Development of an oil find

In connection with the licencing round in 2004 it was estimated that development of a hydrocarbon find in Greenland would cost tens of billions of DKK. Development will be of a size and scope and in an environment that will mean that the main contracts will be extremely large and the technology needed for development will be "front end".

Such activity will clearly affect Greenland society considerably, including the labour market.

From the licence holders, development will be put out to tender as a few main contracts or subcontracts of a size which will make it difficult for Greenland businesses to offer tenders. The overview below shows an example of how the main contracts expected in development of an oil field could, in principle, be divided (depending on the model chosen):
5.1. Employment, education and commercial aspects

- Offshore development
- Pipeline to the shore
- Onshore plant

The main contracts linked to development of an oil field can only be supplied by the very largest companies in the field such as the Aker Kvaerner Group, with more than 20,000 employees. The contribution from Greenland could cover small subcontracts under the main contract such as:

- Sea and air transport
- Telecommunications
- Hotel and accommodation
- Operation of local storage facilities

5.1.3 Operation of an oil field

After development, the oil field will enter the operating phase. The qualifications demanded by oil companies for operating an oil field are very different from those required to develop the field. In addition to permanent drilling personnel working on the rig, in connection with the actual operation of the rig a large number of maintenance and service functions will be put out to tender, for example:

- Painting the rig
- Security
- Maintenance of electrical installations
- Catering services
- Medical services
- Offshore nursing services
- Laundry and supply of work clothes
- Sea and air transport to and from the rig
- Maintenance of main generator
- Maintenance of turbine
- Single anchor loading
- Chemical supplies
- Gas supply
- Maintenance of lifeboats/rafts
- Servicing cranes
- Repair and maintenance of valves, compressors and pumps
- Rig inspection
- Operation of local storage facilities
- Xmas Tree service (valve located at the well top)

Contributions from Greenland to operation of a rig could include service contracts for some of these functions.

In addition there will probably be increasing involvement of Greenland businesses over time, as they develop competencies relevant to the oil industry.
5.1.4 Manpower and education requirements in the Greenland oil industry

The manpower requirement in the Greenland oil industry depends very much on the level of the activity in the oil industry. In 2002, Greenland mineral development and exploration represented 19 man-years.5

Before actual development of an oil or gas field there will only be very modest effects on the local labour market in addition to the current about 20 man-years employed in mineral development and exploration. The most important effects from actual development of a field will come from test drillings.

During test drilling for the Fylla license there was a brief impact of the Greenland labour market. There was a rise in demand for hotel staff, pilots, sailors etc. However, the test drilling at Fylla finished after only about three months.

If exploration reveals hydrocarbons and the find is deemed commercially viable, it is estimated that in Greenland there will be between 100 and 1,000 jobs connected to development of a field, depending on whether it is an oil or a gas field.

In connection with Fylla drilling, on the basis of international experience a number of estimates were made of the impact on the Greenland labour market of possible development. These estimates are reproduced in the section below. Development of Fylla never took place as hydrocarbons were not found, but the estimates of impacts on the labour market from development have not changed since the drilling. It should be borne in mind that development will only take place if there are very large finds of hydrocarbons.

5.1.5 Employment etc. in the development period for an oil field

The table below shows estimates of local employment in support functions onshore from development of an oil find. The majority of the activities will be offshore, but there will be a need for supplies to and from storage facilities onshore, patrol vessels, travel administration etc.

<table>
<thead>
<tr>
<th>Number of people</th>
<th>Greenland labour</th>
<th>Foreign labour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport to and from rig, patrol vessels etc.</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>Supplies, storage, waste management</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Clinic, accommodation, travel service, catering</td>
<td>27</td>
<td>12</td>
</tr>
<tr>
<td>Safety, training, maintenance</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Sundry skilled and unskilled manpower</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>87</strong></td>
<td><strong>33</strong></td>
</tr>
</tbody>
</table>

Source: Nuna Oil (estimate based on international experience)

Tabel 5
Manpower employed through local subcontractors.
The estimate of the need to call in manpower is based on the assumption that it will be hard to find native personnel with vocational qualifications and experience in the hydrocarbon sector. However, much will depend on education policy and the companies’ recruitment policy.

It has been assumed that reservoir management, drilling operations and construction of undersea wells will be carried out by foreign suppliers and licence holders. These will probably not be permanently resident in Greenland.

On the basis of an average contract hourly rate of DKK 200 – 250, the annual local wage cost in the development period will total about DKK 25-80 mill.

According to the input/output table for Greenland (Statistical yearbook for Greenland) DKK 1 mill. spent on private or public-sector consumption provides direct or indirect employment for 1.8-2 people. Under the assumption that neither employees nor the public sector save the money, salary payments to locally hired manpower will thus lead to local employment of 50-140 people.

Estimates on the basis of the input/output table are maximum estimates as they show the average situation when the table was constructed. With growing demand, much will be covered by efficiency improvements and therefore not give rise to additional employment. It will perhaps not be possible to remunerate other parts of the demand locally in the relatively short term, and this will not provide additional employment, but on the other hand it will lead to increased imports, irrespective of the average figures in the input/output table.

Furthermore there will be a large foreign workforce, employed by foreign suppliers, and this is expected to give rise to significant local demand, which cannot be immediately estimated.

5.1.6 Employment etc. in the construction period for LNG installations (natural gas installation)

In much of the construction period of 2-4 years, it is estimated that 500 to 1,000 people will be employed in developing a gas find with an LNG installation. Of these, it will probably be possible to employ about 300 through local subcontractors.

The table below shows estimates of the functions which typically could be filled using local suppliers of manpower.

<table>
<thead>
<tr>
<th>Number of people</th>
<th>Greenland labour</th>
<th>Foreign labour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipping, stevedoring, harbour services, marine/ice services</td>
<td>40</td>
<td>2</td>
</tr>
<tr>
<td>Transport to/from rigs, communication, telecommunications</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>Harbour services, ice services</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>Airport and helicopter pads, maintenance</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Transporters, container facilities, storage, waste management</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Catering, hotel, restaurant, housekeeping, printing, photograp</td>
<td>34</td>
<td>6</td>
</tr>
<tr>
<td>Clinic, accommodation, travel services, helicopter charter</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Safety training, road and building maintenance</td>
<td>40</td>
<td>8</td>
</tr>
<tr>
<td>Sundry skilled and unskilled manpower</td>
<td>36</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>270</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>

Source: Nunaoil (estimate based on international experience)
As can be seen from the table, there will be possible employment for about 300 people. On the basis of the same assumptions, estimated annual salaries will be about DKK 150-250 mill. The derived employment is estimated at 300-450 people per year. Furthermore there will be a large foreign workforce, employed by foreign suppliers, and this is expected to give rise to local demand, which cannot be immediately estimated.

5.1.7 Employment etc. in the operating period for oil or gas fields

During the operating period there will be a requirement for personnel for onshore support functions, production monitoring, and to crew the production vessel (oil production) or personnel to operate the LNG plant (gas production). The total personnel requirement will be of similar size for either oil or gas production.

It has been estimated that in the short term it will not be possible to find local manpower with experience in the hydrocarbon sector for management and specialist positions. As local expertise is developed, these positions can be taken over by local manpower. However there will probably still be foreign employees.

Salary costs will amount to about DKK 25-50 mill per year. Salary payments can give rise to derived employment of about 50-90 people.

<table>
<thead>
<tr>
<th>Number of people</th>
<th>Greenland labour</th>
<th>Foreign labour</th>
</tr>
</thead>
<tbody>
<tr>
<td>In operating period</td>
<td>60</td>
<td>40</td>
</tr>
</tbody>
</table>

Tabel 7
Permanent jobs in the operating period.

Source: Nunaoil (estimate based on international experience)
5.1.8 The labour market in Greenland

There are about 38,0007 people of working age in Greenland. Of these, the workforce amounts to about 28,000, of whom about 3/4 were born in Greenland. Unemployment amounts to around 1,600 people.

Given the size of the labour market in Greenland, any development of a gas field will lead to considerable impacts on the local labour market. Oil companies’ ability to pay in connection with development will probably mean that there will be bottlenecks in the local labour market and a consequential over-heating where employers outside the oil sector will have recruitment problems. These bottlenecks will probably have to be relieved by importing manpower.

The oil industry in Greenland will probably also have an international character as, apart from Nunaoil, all licence holders will come from outside Greenland and these licence holders will always bring with them many oil industry specialists.

Developing competencies within the oil industry takes a long time. Comparing developments in Denmark or Norway, it can be seen that these countries did not have specialist competencies in the area when oil exploration first took off in the 1960s. Only many years after foreign experts and oil companies had made financially viable finds and put them into production did a natural basis grow for a domestic oil industry in these countries.

It is important to note that local competence development enabling local supplies to the oil industry should be at a pace compatible with the economy and oil exploration.

It would be pointless to educate oil specialists in Greenland, if it turns out that it is not possible to start commercial oil production in the country. The time horizon and uncertainty linked to oil exploration mean that, at the moment, education policy should not be targeted at the oil industry, but rather towards the existing labour market. Assuming that commercial finds of hydrocarbons are made in Greenland, a great deal of the oil industry’s demand for local manpower will be for people with vocational qualifications such as sailors, divers, metal workers, electricians, harbour and logistics personnel, IT specialists, hotel and catering staff, engineers, geologists, office staff, builders, pilots, steward(esse)s, airport personnel etc.

Instead of concentrating on educating oil specialists now, efforts should focus on training the local workforce.

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### Table 8

The labour market in Greenland in 2002.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Man-years</th>
<th>Of whom born in Greenland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public administration and service</td>
<td>13,283</td>
<td>82%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2,276</td>
<td>89%</td>
</tr>
<tr>
<td>Livestock, hunting and fishing</td>
<td>1,970</td>
<td>77%</td>
</tr>
<tr>
<td>Building and construction sector</td>
<td>1,978</td>
<td>57%</td>
</tr>
<tr>
<td>Transport activities</td>
<td>1,658</td>
<td>70%</td>
</tr>
<tr>
<td>Other sectors</td>
<td>6,886</td>
<td>48%</td>
</tr>
</tbody>
</table>

Source: Statistics Greenland
According to the Mineral Resources Act the authorities are empowered to lay down the amount of Greenland manpower or Danish manpower that should be employed in connection with a licence for exploration and exploitation of mineral resources. If it is necessary for the company, the licence holder may use foreign manpower when manpower with corresponding qualifications does not exist or is not available in Greenland or Denmark.

The authorities are also empowered to lay down the extent to which contracts, supplies and services linked to a licence for exploration and exploitation of mineral resources must utilise Greenland companies and firms. Other companies may be used, however, if the Greenland companies are not competitive from a technical or commercial perspective.

In line with the above, a model licence for exploration and exploitation of hydrocarbons offshore West Greenland stipulates that, as a point of departure, licence holders must use manpower from Greenland or Denmark, except in situations where qualified manpower does not exist or is not available in Greenland or Denmark. The licence also stipulates that, as a point of departure, the licence holder must use Greenland companies and firms unless these are not technically or commercially competitive.

Moreover, the model licence states that, if finds of hydrocarbons are made, the licence holder must prepare a socio-economic report prior to initiating exploitation activities. This report should describe how local socio-economic interests can be taken into account. The report must be approved by the Bureau of Minerals and Petroleum.
5.2. Socio-economic planning

The socio-economic report by oil companies could draw on experience in the area from Canada. According to Canadian legislation, a number of materials must be prepared in connection with all large mineral projects to document the consequences a project.

A minimum of five large reports must be made:

- Firstly, the application itself including a brief review of the objective of the project together with a description of the possible consequences of the project, both for the community and for the province in which the project is to take place.

- Secondly, a more detailed project description which, in addition to the actual objective of the project, should also contain a detailed review of the various phases of the project, including an overview of the technical and financial aspects.

- Thirdly, there should be an Environmental Impact Statement/Assessment (EIS/EIA) – reviewing the environmental assumptions and consequences of the project.

- Fourthly, there should be a similar Socio-economic Impact Statement/Assessment (SIS/SIA) – providing social assumptions and consequences of the project.

- Finally, a Benefit Plan should be prepared. This is a plan of the social benefits of the project.

A SIS assesses the direct impacts of the project and the indirect run-off impacts in both the long and short terms.

The direct impacts are changes in the socio-economic conditions linked directly to the project. For example that some of the manpower must move from some towns to others as a result of the project.

Indirect, run-off impacts are the possible impacts of the project on society other than the direct consequences. For example moving manpower from various towns for the project will have a number of impacts on these towns, for example lost tax revenues and perhaps also less need for schools and daycare centres.

There are requirements that, as a minimum, the following problems are covered by the analysis:

- Business and employment
- Demography
- Construction
- Social infrastructure and social services
- Public infrastructure and public facilities
- Municipal administration
- Fisheries
- Land use and use of resources
- Socio-cultural problems
The analysis should start from a “baseline description,” i.e. a status report for each of the areas mentioned above. This status report is a general description of conditions at the time the project is to start. There should be both a quantitative and a qualitative description of the conditions, based on source materials available to the public.

On the basis of this, there should be an assessment of the impacts of the project, including:

- an assessment of the direct consequences, such as impacts on employment, types of qualification necessary, housing needs, need to call in specialists, development of infrastructure, etc.
- the direct run-off impacts of the anticipated developments, for example how the required education programmes are to be established, called-in specialists and their families’ needs for child-care facilities, schooling etc.
- the more indirect run-off impacts of the anticipated developments such as an assessment of the businesses which would suffer negative impacts because people with specialist education are moved away from these businesses to the new activities.
- how the project can be organised in order to optimise the local employment and commercial effects of the project.
- on the basis of these analyses, as assessment of the overall costs and benefits of the project. The scope of the benefits will very much depend on the ability of local businesses and the labour market to enter into agreements to supply the services demanded.

Preparation of the various consequence analyses will be the responsibility of the company wanting to set up business. However, the analyses will have to be approved by the public authorities. As a result of this, companies almost always decide to commission an independent consultancy firm to make the analyses so that there can be no doubt about their impartiality.

A first step in a SIS is to specify the problems to be included in the analysis. An important aspect is that the analysis should not only include the primary consequences but also the indirect and secondary consequences, this means that the stakeholders at many different levels will have to be involved in the analysis.

The analysis will typically start with mapping the stakeholders involved and subsequently consulting these about their immediate interests in the project. This consultation will usually include the government and its administrative bodies, municipal administrations, unions and employers’ organisations, as well as other commercial interest organisations. The consultation will usually start by aiming at mapping the themes to be included in the analysis.

As a supplement to this there will be a public phase, where the public sector and selected key people will be able to see the outline project and contribute to structuring the analysis itself. In Canada, various forms of contact with the public sector have been used, and very positive results have been seen in, for example, open-house events for the public sector.
• During 2005 and 2006 a baseline Social Impact Assessment will be prepared in order to set a reference framework for oil companies when, prior to initiating large activities, they are to prepare socio-economic reports on how local socio-economic interests are to be taken into consideration.

There will be status reports for the significance of a number of areas for oil and gas activities, including business and employment, demographics, housing, social infrastructure and social services, public infrastructure and public facilities, municipal administration, fisheries, land use and consumption of resources, as well as socio-cultural issues.

• Exploration and exploitation licences should continue to contain requirements regarding education and as far as possible employment of local manpower and companies. To the appropriate extent and at a suitable rate in relation to progress of hydrocarbon activities, these provisions should be supported by more detailed statutory orders.

• Competence development in Greenland in the oil and gas area should progress as an integrated part of the overall education policy for Greenland.

5.3. Action plans for employment, education and business
6. Safety, health and the environment

All activities in Greenland involving mineral resources are subject to the requirements laid down in the Mineral Resources Act for a licence to be granted by the authorities prior to initiating such projects. As regards environmental regulation, Part 10 of the Mineral Resources Act states specifically:

§ 23. Activities under licences under sections 6 and 7 shall be carried out in accordance with good international practice in this area under comparable conditions. The activities shall be carried out in a safe and environmentally acceptable manner, in an appropriate way as regards exploitation with a proper use of the resources.

§ 24. With respect of legislation whereby jurisdiction has been vested in other authorities the Greenland Home Rule Government may lay down rules for the carrying out of activities under licences under sections 6 and 7 within and outside of the licence area, cf. section 5, subsection 1, including rules regarding technical, safety, environmental, and resource aspects.”

The Bureau of Minerals and Petroleum is responsible for authority tasks relating to the protection of the environment for mineral resources activities. This responsibility is specified in the special mineral resources system between Greenland and Denmark, which states that all significant authority functions regarding mineral resources activities shall be vested in the Bureau of Minerals and Petroleum.

As regards the management of the environment, under the 1998 Mineral Resources Agreement between the state and the Greenland Home Rule Government, the Bureau of Minerals and Petroleum draws upon the scientific expertise in the National Environmental Research Institute, Department of Arctic Environment (AM).

6.1. Phases in hydrocarbon exploration and exploitation

In Greenland, prospecting/exploration/exploitation of oil and gas – i.e. hydrocarbons – are carried out both onshore and offshore on the Greenland continental shelf. Hydrocarbon activities include the following phases:

- Prospecting without exclusive rights, including collection of data (for instance seismic and aeromagnetic data)
- Exploration licence with exclusive rights, including:
  - Collection of additional seismic data
  - Exploration drilling
- Exploitation licence with exclusive rights, including:
  - Development phase
  - Production phase (permanent drilling)
  - Termination of activities
  - Monitoring
6.2. Environmental hazards

6.2.1 Oil spills

The most severe risk of environmental impacts caused by hydrocarbon activities is pollution from oil spills. Large oil spills may result from accidents, for instance during drilling or reloading and transporting oil. The impact of oil spills depends on a number of different factors, e.g. the type of oil, the location of the spill site in relation to sensitive areas, and the weather at the time of the incident. Most offshore oil spills take place on the surface of the sea. In connection with drilling in deep waters, oil from a blow-out may spread from the bottom of the sea into the water masses, and no or only minor traces of oil are visible on the surface of the sea.

Oil spills in the open sea will normally not impact the environment as much as oil spills in coastal waters, since the oil is diluted and spreads much more quickly over large areas. Moreover, biological resources are often more dispersed in the open sea than at the coast. In coastal waters, the oil may be caught in bays and fiords, and, if it remains there for some time, the concentration of oil components in the water may become toxic to fish and other animals, especially to eggs and larvae. Large schools of fish spawning near the coast are particularly vulnerable. Sea birds, which are very sensitive to oil spills, may occur in large concentrations in coastal waters, for instance on breeding grounds, and in moulting and foraging areas. Oil spills in areas with ice may accumulate in holes and crevices in the ice and along the ice edge - locations that are often vital to both sea birds and marine mammals, partly because of the open water, and partly because of the favourable foraging conditions they often offer. Onshore oil spills are often more limited, unless the oil spreads to streams and lakes.

To conclude, oil spills are only rarely caused by accidents during exploration drilling, or during production and transport of oil. The probability of a large oil spill is very modest, and the impacts on nature and the environment are highly dependent on the circumstances in which the spill occurs.

A report from 2002, published by the National Research Council (U.S. National Academy of Sciences) estimates that total spills of petroleum (oil) worldwide from all known sources amount to 1.3 mill. tonnes. According to the report, the main sources are:

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural seeps from the subsoil</td>
<td>46%</td>
</tr>
<tr>
<td>Discharges during the operation of vessels and from activities onshore</td>
<td>37%</td>
</tr>
<tr>
<td>Release from vessels caused by accidents/incidents</td>
<td>12%</td>
</tr>
<tr>
<td>Oil spills in connection with exploration/exploitation</td>
<td>3%</td>
</tr>
<tr>
<td>Other sources</td>
<td>2%</td>
</tr>
</tbody>
</table>
6.2.2 Seismic surveys

In many respects, impacts from prospecting and exploration can be compared to other general activities in Greenland’s nature and environment. At sea, impacts are usually not larger than impacts from shipping and fisheries. Seismic surveys hold a larger potential for disturbing marine mammals and fish; however, the impacts are limited in time. In Norway, it is assessed that very intense seismic surveys may in the worst case scenario affect recruitment to a number of important fish populations. However, for the impact to be this severe, spawning has to be highly concentrated in terms of both time and geography, and has to take place at the same time as the seismic surveys. These circumstances are not very likely to happen in Greenland, since most important fish species spawn in periods where seismic cruises do not take place, and moreover, most species visit different spawning sites.

6.2.3 Drilling operations

Exploration drilling projects take place at one or a few specific locations. The major element in the conflict with nature protection interests is noise from the rig/drilling vessel. Noise is emitted during the drilling process and by the propellers that keep the rig/vessel in position.

Helicopters flying low to and from the rig may be very disturbing, mostly to animals living onshore or along the coast. Moulting geese, colonies of breeding sea birds, and walrus at haul-out sites are particularly sensitive to low-flying helicopters.

Thorough planning of drilling activities, with due regard to any sensitive whale populations and fishing interests, may prevent negative impacts, and all drilling activities should be based on the best available technological and safety solutions.

Trawling is one of the most disturbing activities. It changes the physical structure of the seabed, and the composition of benthic animal societies. In Greenland, shrimp fishing affects very large seabed areas offshore West Greenland, from Cape Farewell to the southern part of the municipality of Upernavik, with impacts over much larger areas than those of other activities, for instance test drilling.

6.2.4 Onshore activities

Among the impacts from onshore activities are damage to vegetation and the ground. Calving reindeer and musk oxen, moulting geese and colonies of breeding birds are sensitive to disturbing activities. Impacts are most often limited in time. Damage to the terrain and to vegetation is caused mainly by vehicles driving around, for instance during seismic surveys and construction of drilling and exploration sites. Water erosion may exacerbate the damage from vehicles even further, and areas of permafrost are particularly vulnerable.

An onshore oil field affects vegetation and the terrain in adjacent areas. Also animals will be affected in the areas close to the oil field and along transport corridors, because of noise and the people working in the oil field. Many of these impacts can be prevented by regulatory measures based on extensive knowledge of natural history and ecology. Helicopters must fly in special corridors, so that sensitive animals do not become exposed or get used to the disturbing activities.
6.3. General information on regulation of hydrocarbon activities

6.3.1 Licencing

When a company obtains the right to carry out prospecting, and to explore and to exploit mineral resources in a specific area in Greenland, the prospecting licence (including “Standard terms for prospecting licences. Hydrocarbons”) or the exploration and exploitation licence (based on the politically agreed model licence) stipulates that the activities of the company must be approved by the authorities before they are initiated.

Licences are awarded on the basis of work programmes for seismic surveys, drilling, development, production etc. In addition to a general description of the overall work and the way it will be carried out, the programmes include an environmental assessment of the activities, safety plans, environmental protection plans, emergency response plans, and preparedness plans with measures to be taken in the event of large icebergs approaching the drilling vessel/rig.

6.3.2 Environmental Impact Assessment - EIA

Assessments of impacts on the environment must be carried out along the lines required for Danish EIA (Environmental Impact Assessment) reports. Assessments must be made before the projects are initiated, and should address the impact of projects on the surroundings. Specific assessments also include the impacts resulting from daily operations, such as impacts of possible accidents on the biological environment (flora and fauna) as well as the physical environment (for instance damage to the terrain).

In connection with major projects, for instance the development an oil field, an assessment must also be made of the impact on society.

6.3.3 Environmental Protection Plan

The Environmental Protection Plan sets out guidelines to be followed by companies in their daily operations, ensuring that the impacts on the environment are reduced and kept within the limits approved by the competent authorities. The plan specifies which types of xenobiotic substances can be used, and describes the manner in which sewage, waste, chemicals, fuel, drilling mud etc are to be managed. The plan also presents procedures for cleaning up minor spills of fuel and oil related to operations, for remedying damage to the terrain, and for protecting vulnerable areas and animal life etc.

Further, the plan addresses the use of the most environmentally friendly substances and technical solutions, and efforts to reduce activities in biologically sensitive periods and areas.

6.3.4 Emergency Response Plan

The Emergency Response Plan addresses procedures for containing and cleaning up possible oil spills. Minor spills must be managed by the company by means of clean-up equipment staged appropriately in relation to the drilling operations. For major spills, efforts by the responsible company are supplemented by international emergency response companies with special skills, and by the authorities in the country likely to be affected by the incident. In this scenario, all actors cooperate in the deployment of equipment and abatement agents which exceed the response to be expected from the company alone.

Abatement of large oil spills is a major task, based on coordinated efforts by several actors: authorities, companies and individuals. Detailed planning is therefore required in order for abatement to be effective. Authority efforts are coordinated in an Action Committee, including relevant public authorities.
6.4.1 Seismic and helicopter surveys

Seismic surveys are regulated in accordance with “Seismic survey standards for offshore West Greenland.” Under these rules, the licence holder must, prior to the surveys, submit an application to the Bureau of Minerals and Petroleum, presenting the operations planned.

The application must include:

• A description of the operation plan
• A preliminary EIA
• The Safety Plan, the Environmental Protection Plan, and emergency response plans

The EIA and the Environmental Protection Plan etc. must be based on the NERI “Preliminary Environmental Impact Assessment of Regional Offshore Seismic Surveys in Greenland,” which describes how intensive seismic surveys can be minimised by organising activities in a manner which ensures that particularly sensitive areas and periods are not affected.

It appears from the publication that lumpfish and capelin spawn in coastal shallow waters from April to June, and that such areas must be kept free from seismic activities in this period. Another example is the Melville Bay, where the area north of 75°30’ N must be kept free of seismic activities in the autumn migration period of beluga and narwhale from late September to mid October.

A third example is helicopter operations in connection with mineral resources activities: helicopters are not allowed to fly closer than 5 km to colonies of polar guillemot, and not closer than 200 m to other colonies. Moreover, altitudes must exceed 500 m above sea/ground level in specially designated areas of walrus and narwhale.

6.4.2 Spills – prevention and emergency response

The best protection against oil spills is to avoid the accidents causing the spill. Therefore, preventive action is essential, for instance in the form of detailed planning, use of the most reliable equipment, and thorough monitoring of safety and inspection of material. If accidents do happen, it must be possible to respond immediately.

During drilling, oil spill from a blowout is prevented through training and education of personnel. The drilling crew must be able to interpret the pressures measured regularly during drilling, and, on the basis of measurements, regulate the weight of the drilling fluid and operate safety valves, also known as blowout preventers.

When operating in offshore areas, fast ice or drifting icebergs are likely to present another accident hazard which – in the worst case scenario – may result in oil spill. Very large drifting icebergs may affect the manner of navigating or drilling in the area. For instance large drifting icebergs may draw so much water that they present a risk to installations on the seabed, for instance safety valves at drilling holes. Therefore, authorities require that plans be drawn up on how to react to icebergs, and on easy access to equipment to launch such plans.
However, it is worth noting that, during the five drilling projects offshore West Greenland in the 1970s, there were no problems with icebergs. During the drilling project at Fylla Banke in 2000, operations were interrupted for a total of 28 hours because of drifting icebergs. The 28 hours should be compared to the 600-hour disruption resulting from technical problems during drilling. According to Statoil, the 28-hour interruption caused by icebergs may perhaps have been reduced to only a few hours, since field personnel learned more about how to interpret data on currents, tidal water and drift patterns.

Oil spills do not remain within the spill site, but will, depending on a number of physical factors – current, tidal water and wind - move away from the spill site. The very first response to an oil spill incident is therefore rapid deployment of containment booms to prevent spreading and enable recovery of the oil. Contained oil is pumped into barges, vessels or floating tanks, and transported to onshore receiving facilities, in order to be decomposed. This procedure is used during daylight, in calm and clear weather.

If weather conditions do not allow the use of containment booms, dispersion may be a suitable response. By dispersion, chemicals spread over the spilled oil promote mixing of oil in the water column, and, thus, remove the oil from the surface of the sea. The dispersion operation can take place from a vessel or an aeroplane, and the method can therefore be used instantaneously. The method is most effective on new spills of light oil types, and the dispersants can only be used during daylight. Contained oil can also be managed by in-situ burning, directly on the surface of the sea.

During trials, up to 99 per cent of the oil was removed from the surface of the sea.

Coasts which – for reasons of biology or fishing/hunting interests – are particularly sensitive, can be protected by containment booms. Coasts affected by oil spills often have to be cleaned up, using methods adapted to the nature of the coast. By way of example, oil on sandy beaches may be removed by scrapers, and rocky coasts can be washed manually.

Bioremediation enhances the ability of naturally occurring oil-degrading bacteria to degrade oil in water or on land. The biological method is particularly efficient for beached oil, but the process is less efficient in cold weather. Oil is poor in nutrients, such as nitrates and phosphates, and therefore the oil should be fertilised with these substances in order to have the best possible result.

If oil spills occur in icy waters, this must be taken into account in emergency response plans.

6.4.3 Regulation in the 2004 licencing round

Issues regarding health, safety and environment (in short:HSE) within the hydrocarbon sector are relevant to a number of authorities, and it is therefore important to draw up clear guidelines on the distribution of responsibility within different sectors. HSE regulation should be updated and capable of providing the basis for reliable emergency regimes.

The Mineral Resources Act is a framework act, delegating powers to the Greenland Government to regulate...
technical, safety and environmental matters, including HSE. However, aspects of health are regulated specifically in the Working Environment Act and the Safety at Sea Act. Further, the Mineral Resources Act takes account of possible overlap of regulation in the Bureau of Minerals and Petroleum, the Working Environment Authority, the Danish Maritime Authority, and the Danish Civil Aviation Administration.

Up till now, the need for regulating matters of exploration drilling has been met by approval of detailed project terms, rather than by general regulatory measures.

6.4.4 Offshore facilities

In the 2004 licencing round, the Bureau of Minerals and Petroleum prepared guidelines for applications for approval of offshore facilities for hydrocarbon exploration in Greenland, focusing specifically on HSE (Health, Safety and Environment) requirements. The guidelines specify authority requirements for meeting good international practice in this field, and what is considered to be sound in terms of safety and the environment in connection with approval of licences to use offshore facilities for oil and gas exploration.

Prior to launching an exploration drilling project, operators must submit an application to the authorities, asking for a drilling licence. The application must include: specific information on plans for carrying out the project in accordance with good international practice in the sector, including systems for HSE, safety and control, manpower, working procedures, weather and ice warning systems (with a view to temporarily closing down the project, if needed), and emergency response plans. Moreover, the application must include an environmental impact assessment of the planned activity.

When preparing and implementing the drilling project, authorities will supervise the project regularly in order to see that the licence terms are observed, and that the operator’s safety and control systems run satisfactorily.

As a minimum, the operator’s oil emergency response plans must include a description of the organisation, personnel, alarm and warning procedures, abatement strategies and location of equipment, communication set-up, indication of where possible major oil spills will be contained and cleaned up, procedures for disposal of collected oil, surveillance of the extent of spills, protection and clean-up of coasts. Moreover, cooperating with the authorities, operators must develop long-term monitoring plans aimed at monitoring concentrations of oil and environmental impacts resulting from oil spills.

Further to the licence holders’ duty of preparedness, the public authorities have established an emergency preparedness facility, which will apply when accidents take place. The emergency preparedness facility consists of the Police; the Greenland Command; the Danish Maritime Authority; the Danish High Commission in Greenland, the general preparedness of the Greenland Government, and the Bureau of Minerals and Petroleum.
6.4.5 Model licence

A model licence has been drawn up, setting standard terms for all licences. The general terms of the model licence regulate the licence period, third-party activities in the licence area, technical and environmental aspects, agreements on further training, procedures for approval of activities, supervision, obligations upon termination of the activities, reporting, manpower and supplies, joint cooperation agreement among licence holders, transfer of licence, insurance and guarantees, obligations upon termination of the licence etc.

The model licence sets out a number of requirements regarding HSE in connection with activities within an exploration and exploitation licence.

According to these requirements, the licence holders must submit plans for instance on:

- exploration,
- health, safety and environment,
- socio-economic studies,
- development,
- production, storage and transport,
- termination of activities.

The plans must be approved by the Bureau of Minerals and Petroleum. All plans must address preparedness in connection with oil spills. Activities cannot be initiated before the approval has been granted. In the approval, the Bureau of Minerals and Petroleum may decide that specific equipment and material may not be used, or that activities may not be carried out in specific areas and periods. Similarly, the Bureau of Minerals and Petroleum can order the licence holder to monitor biological and physical conditions in areas affected by the activities.

Moreover, the model licence stipulates that:

If the activities carried out by the licence holder endanger persons or third-party properties, or if the risk of pollution or negative impact on environment and health exceeds a level acceptable to the Bureau of Minerals and Petroleum, the Bureau of Minerals and Petroleum may order the licence holder to make any necessary changes to such activities within a time limit set by the Bureau. If considered necessary, the Bureau may further order the licence holder to suspend the activities in whole or in part, until the licence holder has carried out the necessary changes. The Bureau may also, to a reasonable extent, order the licence holder to remedy any environmental or health damage falling within the scope of the licence holder’s liability.
Other important changes compared to the 2002 model licence include legislation providing for transport by ship of hydrocarbons from the Greenland continental shelf. Such transport shall meet specific terms regarding ships carrying such products, for instance:

- EC Regulation 1726-2003 on phasing-in double-hull tankers.
- Current Guidelines for Ships Operating in Arctic Ice-covered Waters approved by IMO.
- One or more current industrial standards, codes and guidelines for lightering operations, bunkering etc. that are relevant under Arctic conditions, and acceptable to the Bureau of Minerals and Petroleum.
- Ships must be classified with a company recognised by the EU, and as a minimum meet the requirements of Polar Class PC 5 (defined in IMO Guidelines for Ships Operating in Arctic Ice-covered Waters of 23 December 2002), or similar classification, unless otherwise accepted by the Bureau of Minerals and Petroleum.
- The age of a ship must not exceed 15 years from the date it was built.

6.4.6 Preliminary EIA

In connection with the 2004 licencing round, NERI prepared a preliminary Environmental Impact Assessment, as part of the official licencing material. The preliminary EIA forms the basis for the baseline and EIA Studies to be made by all consortiums. The NERI preliminary EIA covers all aspects included in the 2004 licencing round, addressing for instance the following issues:

- The physical environment.
- Ecosystems and fishery.
- How expected exploration activities may affect the environment.
- Environmental impacts from seismic surveys.
- Environmental impacts from exploration drilling.
- Environmental impacts from oil spills.
- Regulation, monitoring and minimisation of possible environmental impacts.
- Exploitation.
- Activities during the winter.
- Collection of further data.
6.4 General information on reduction and prevention in the hydrocarbon sector

6.4.7 Environmental atlas of Greenland offshore areas and fiords

Another official document relating to the 2004 licencing round is the NERI "Environmental Oil Spill Sensitivity Atlas of Greenland".

The atlas allows oil companies and authorities to set up the best possible preparedness regime in case of oil spills, thus minimising damage to nature and the environment.

The atlas gives an overview of local wildlife, local fishing and hunting interests, and archaeological sites that are particularly sensitive to oil spills. Further, the atlas gives information on the physical aspects – coastal types and oceanography – logistics and oil-spill response methods.

The atlas is divided into three sections, describing the entire area from Cape Farewell (60° N) in the south, to the southern part of the municipality of Upernavik (72° N). The atlas divides the coast into four segments of approx. 50 km and of varying sensitivity. Calculation of sensitivity is based on a number of environmental and social elements, for instance birds and marine mammals, hunting and fishing areas, and archaeological sites. These data are used to draw up a map, indicating the sensitivities. A special map shows particularly endangered and important species and areas.

The atlas allows better management of the state of the environment in case of oil spills, both as a tool to plan satisfactory preparedness in relation to oil activities, and to plan action to be taken in case of oil pollution. The atlas is now being used for approval of the emergency response plans to be drawn up by oil companies operating along the West Greenland shoreline. The atlas is, thus, a valuable element of overall preparedness in connection with oil exploration. Similar atlases have been drawn up for areas in Northeast Canada.

6.4.8 The physical conditions of West Greenland

For the licencing round, the Danish Meteorological Institute and the Bureau of Minerals and Petroleum prepared the report "Weather, sea and ice conditions offshore West Greenland – focusing on new license areas 2004". The report addresses issues relating to climate, sea and ice conditions in the licence areas and the surrounding sea area.

The report aims at describing the importance of the physical environment to hydrocarbon exploration and exploitation offshore West Greenland, and focuses especially on the four licence areas. The report gives an overview of the frequency and thickness of sea ice, and the prevalence and character of icebergs, wind, current and waves.

The purpose is to update industry on the operational conditions in connection with hydrocarbon exploration and exploitation, and, further, to provide basic knowledge of the importance of such conditions for the organisation of HSE management systems operated by the oil companies.

6.4.9 Further information

• Download all official documents relating to the licencing round 2004: www.bmp.gl/petroleum/2004_Licensing_Round.html

• Read the preliminary EIAs for the licencing round: www.bmp.gl/petroleum/hse.html

6.5. Safety, health and environment action plans

- With the purpose of including the area offshore Disko-Nuussuaq in the coming hydrocarbon licencing policy, the Greenland Government has, in accordance with good international practice, initiated the preparation of a strategic regional EIA in the area.

- The strategic EIA will focus on the environmental impacts of oil activities, addressing in particular:
  A) Impact on biodiversity;
  B) Impact on the structure and function of the ecosystem;
  C) Impact on other sectors which depend on the state of the environment in the area (fisheries, hunting, tourism).

- Activities carried out in connection with the EIA:
  o Organisation of data in a GIS system,
  o Possible impacts on shrimp and halibut from oil spills,
  o Baseline studies of natural oil concentrations in the area,
  o Studies of the importance of the sea ice edge zone to the food chain,
  o Studies of whale populations in the area,
  o Estimates of bird populations in the area,
  o Studies of walrus populations in the area.

- Studies will also be made of sea ice, icebergs and other physical framework conditions and their importance to hydrocarbon activities in the area west of Disko-Nuussuaq.

- In 2005/2006, the Greenland Government will complete a new statutory order regulating safety and environment in relation to oil activities. The rules will focus on all phases of oil activities (lifecycle regulation).
7. Summary: Government action plans in brief

The Greenland Government’s policy regarding the social aspects of exploration and exploitation of oil and gas in Greenland contains a number of specific action plans which aim at realising a knowledge base and some framework conditions which are considered attractive by the oil industry and which also take into consideration the public sector’s visions and objectives in developing the hydrocarbon sector into an important part of the economy in Greenland.

Extensive exploration is the first step towards exploitation of oil and gas, and therefore towards realising the vision of developing the mineral resources sector into a sustainable business. Therefore, the authorities will work towards promoting and completing projects which help establish new knowledge about the oil/gas potential with a view to marketing this potential to the international oil industry.

Through active policies, the Greenland Government will ensure that the framework conditions for exploration and exploitation are constantly considered attractive by the oil industry. The sector policy will also ensure society a reasonable share of the surplus from exploitation, and it will secure local insight and knowledge about oil and gas activities. The sector policy will also underpin competence development in Greenland society through the use of local manpower and local businesses as well as education aimed at the local workforce. Furthermore, measures will ensure that the activities take place with appropriate consideration of safety, health and the environment.

The following is a list of the action plans in summary:

### Action plans for oil and gas exploration in Greenland:

#### Choice of licencing procedure

In the course of 2005, an evaluation will be made of experience gained in the 2004 licencing round, with a view to identifying possible needs for adapting the procedure to be used in future licensing policy. As a result of this evaluation it is possible that special procedures will be introduced in the sector policy and be used in connection with open public licencing procedures.

The result of the evaluation will be presented to the oil industry in the course of 2006, with a view to including the views of the oil industry regarding the licensing policy.

A policy for future licencing procedures must be agreed before the end of 2006.
Geological projects and marketing
Projects must be supported and initiated, aiming at collecting new knowledge on the mineral resources potential in the subsoil. Through marketing, the projects may help increase the interest of private companies in exploration activities in Greenland. The projects should address:

- Collection of seismic data in 2005 and in the years after, with a view to preparing a possible licencing procedure in areas that are not open for oil exploration today.
- One of the most significant risks associated with exploration offshore West Greenland is whether the structures revealed by seismic data consist of the types of rock necessary for the formation and storage of oil and gas deposits in the subsoil. Therefore, a number of projects will be carried out in 2005 and subsequent years, documenting the presence of such rock offshore West Greenland. Among the planned activities are: taking seabed samples, analyses of natural oil seeps etc.

Following the licensing round in 2004, a detailed marketing plan will be drawn up in 2005, aiming at presenting the results of the mineral resources projects to selected oil companies. The marketing plan will be implemented from 2006 and onwards.

Competitive regulation
In 2005/2006 an evaluation will be made of the terms set out in the present model licences for gas/oil activities in Greenland, with a view to ensuring that they provide a competitive regulatory framework for the oil industry, by addressing technical and environmental matters, agreements on training of staff, procedures for approval of activities, inspection, reporting, employment, choice of suppliers, transfer of licences, insurance and guarantees etc.

Prioritisation of areas in the licensing policy
Parts of the area between 63°N and 68°N offshore central West Greenland, where data coverage and prospectivity are largest, will be evaluated with a view to inclusion in the next licensing round/special procedure.

In the region between 68°N and 71°N (Disko-Nuussuaq area), a large number of onshore oil seepages have been found, and analyses of satellite imagery suggest the occurrence of natural oil seepages on the surface of the sea. The parts of this area (onshore as well as offshore) which are shown to hold the largest prospectivity, will also be evaluated with a view to inclusion in the next licensing round/special procedure.

An oil/gas licencing round will be prepared as an open-door procedure, or a special procedure in 2006/2007 in the areas specified above.

According to plans, the area offshore southern West Greenland 60°N-63°N will until further notice remain an open-door area, partly because of the very modest data coverage, and partly because of the difficult logistic conditions. In step with improved data coverage, an evaluation will be made to determine whether the area is mature and ready for inclusion in a licence round/special procedure.
7. Summary: Government action plans in brief

Action plans for economic and fiscal aspects:

Further to the benchmark study of the international competitiveness of the current fiscal regime presented in this report, regular evaluation of the fiscal conditions for exploitation of oil and gas should be carried out so that the Government take always reflects the prospectivity of the individual regions.

In connection with the planned preparation of the Disko-Nuussuaq area for issuing new oil and gas licences, the final model for royalties and surplus royalties will be set by the Greenland Government and the State following relevant negotiations in the Joint Committee on Mineral Resources in Greenland. The basis for the models will be:

- partly the result of the geological surveys etc. currently being carried out in the area as preparation for the forthcoming licencing round for the area, and
- partly the most competitive models described in the section “Possible future royalty models”, i.e. the current Greenland model, model 2 or model 9

Up to EM 2005, the Greenland Government will consider the advantages and disadvantages of setting up a hydrocarbon fund with the objectives:

- partly to establish a financial foundation for the considerable investment costs the publicly owned oil company Nunoil A/S will incur in connection with establishment of oil or gas production facilities, and
- partly to manage the potentially considerable revenues from exploiting oil reserves in Greenland so that the development of the oil sector does not lead to undesirable and unnecessary structural problems for the Greenland economy.

Action plans for employment, education and business

During 2005 and 2006 a baseline Social Impact Assessment will be prepared in order to set a reference framework for oil companies when, prior to initiating large activities, they are to prepare socio-economic reports on how local socio-economic interests are to be taken into consideration.

There will be status reports for the significance of a number of areas for oil and gas activities, including business and employment, demographics, housing, social infrastructure and social services, public infrastructure and public facilities, municipal administration, fisheries, land use and consumption of resources, as well as socio-cultural issues.

Exploration and exploitation licences should continue to contain requirements regarding education and as far as possible employment of local manpower and companies. To the appropriate extent and at a suitable rate in relation to progress of hydrocarbon activities, these provisions should be supported by more detailed statutory orders.

Competence development in Greenland in the oil and gas area should progress as an integrated part of the overall education policy for Greenland.
Safety, health and environment action plans

With the purpose of including the area offshore Disko-Nuussuaq in the coming hydrocarbon licencing policy, the Greenland Government has, in accordance with good international practice, initiated the preparation of a strategic regional EIA in the area.

The strategic EIA will focus on the environmental impacts of oil activities, addressing in particular:

A) Impact on biodiversity; B) Impact on the structure and function of the ecosystem; C) Impact on other sectors which depend on the state of the environment in the area (fisheries, hunting, tourism).

Activities carried out in connection with the EIA:

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- Possible impacts on shrimp and halibut from oil spills,
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- Studies of whale populations in the area,
- Estimates of bird populations in the area,
- Studies of walrus populations in the area.

Studies will also be made of sea ice, icebergs and other physical framework conditions and their importance to hydrocarbon activities in the area west of Disko-Nuussuaq.

In 2005/2006, the Greenland Government will complete a new statutory order regulating safety and environment in relation to oil activities. The rules will focus on all phases of oil activities (lifecycle regulation).
Notes

1 For the precise formula for calculating surplus royalty see the model licence for the licencing round in 2004 at www.bmp.gl

2 In this study the term Government take is a common term for taxes, royalties, charges, fees, interest of public oil companies in licenses etc.

3 Oil & Gas Fiscal Regimes Survey – PricewaterhouseCoopers, 2005

4 Either directly or indirectly via the publicly owned oil company Nunaoil A/S.

5 Source: Employment in Greenland 2002

6 LNG is Liquified Natural Gas i.e. natural gas condensed into a liquid.

7 Source: Employment in Greenland 2002

8 Rasmus Ole Rasmussen: “Erhvervs- og arbejdsmæssige konsekvenser af olie- og gas-produktion i Østcanada” (Hydrocarbon production in East Canada - consequences to business and labour), Roskilde University, 2000.
Current publications of the Bureau of Minerals and Petroleum
1. Kulbritstrategi 2003 (only in Greenlandic and Danish)
3. Socio-economic aspects

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