Issues of Decommissioning

*By Petter Osmundsen and Ragnar Tveterås**

Introduction

In the process of developing a decommissioning plan, the oil companies use independent consultants and contractors to carry out environmental assessments, safety studies and cost analyses.[1] These are predominantly technical reports, undertaken by engineers, and they are generally not available to the public. In spite of the interesting policy issues and the large sums involved, decommissioning of petroleum installations seems to have been given scant attention by researchers of economics. We give an overview of the most important economic topics related to decommissioning and disposal, illustrated by recent Norwegian decommissioning policy.

International Decommissioning Issues

There are more than 6500 offshore installations world wide, with an estimated overall removal cost of 20 billion USD. There is a great variety of installations, each designed for a particular set of conditions; ranging from fixed shallow-water structures in 30 metres of water to tension leg platforms in 900 metres of water. Some 490 installations (excluding subsea facilities) are located in the North Sea and the North East Atlantic. The majority of platforms, around two-thirds, standing in less than 75 metres of water or weighing less than 4000 tonnes, are referred to as small structures, although they can still be the size of the Houses of Parliament. The remaining platforms, mainly in Norway and the UK, comprise 112 large steel structures - which may be as high as the Eiffel Tower and have a footprint the size of a football field - and 28 concrete gravity base structures. In addition there are some 26 floating installations. Over the next 10-20 years, an average of 15-25 installations are expected to be abandoned annually in Europe. This represents, amongst other materials, 150,000-200,000 tonnes of steel per year. The continental shelf bordering the states of the European Community and Norway counts some 600 offshore oil and gas platforms, 400 subsea structures and 600 subsea wellheads.

A typical platform consists of the *topsides*, which contain the drilling, processing, utilities and accommodation facilities, and the supporting *substructure* or *jacket*. Steel jackets can weigh up to 40,000 tonnes and are fixed to the seabed by steel piles. The topsides themselves can weigh up to 40,000 tonnes. Concrete gravity base structures are even larger, for example, Troll on the Norwegian continental shelf weighs some 700,000 tonnes, and sit on the seabed, stabilised by their own weight and penetration of the *skirt* into the seabed. In the absence of storing facilities, only the topsides of the platform are in contact with hydrocarbons and may contain limited amounts of potentially hazardous substances, whereas the substructure or jacket is generally clean steel or concrete.

Cost-benefit calculations are in this context needed for two types of decisions: (a) the choice of method of removal and disposal of installations, and (b) timing issues. As for (a), after production is closed down, topsides are in most cases taken to shore for recycling. Interesting policy issues, therefore, mostly pertain to the various solutions for the substructure. The basic decommissioning options are as follows:

i Leave in place.
ii Partial removal, with alternatives (a) emplacement/toppling on site, (b) carry to shore for recycling or disposal as waste, (c) deep water disposal, (e) artificial reefs, (f) re-use/other uses.
iii Total removal, with alternatives (a) carry to shore for recycling or disposal as waste, (b) deep water disposal, (c) artificial reefs, (d) re-use/other uses.

Artificial reefs mean using cleaned offshore platforms to create reefs for marine life. Early evidence indicates that such reefs enhance and protect existing marine habitats and create new habitats for marine animals and plants.[2] Artificial reefs have been developed in the United States, Brunei, Japan, Cuba, Mexico, Australia, Malaysia and the Philippines.

The choice of decommissioning procedure is subject to stringent and extensive international regulations. Still, considerable discretion is left to national governments. In 1958, the Geneva Conference adopted a Convention on the continental shelf, requiring that an offshore installation being abandoned must be entirely removed. The 1982 UN Conference of the Law of the Sea introduced some exceptions, allowing some installations to be left in place as long as requirements linked to navigational safety, fisheries and environmental impact were met. The 1989 UN International Maritime Organisation (IMO) Guidelines for the Removal of Offshore Installations required that abandoned structures standing in less than 75 metres of water and weighing less than 4,000 tonnes in air, excluding the topsides, must be entirely removed.[3] Platforms exceeding those limits need to be cut off to allow 55 metres of clearance between their highest point and the surface. The water depth limit will increase to 100 metres for new platforms installed after 1 January 1998. Disposal at sea of offshore installations in the North Sea or North East Atlantic is regulated by the Oslo and Paris Conventions. These two conventions were merged into one (OSPAR) in 1997. Following the Brent Spar controversy, the OSPAR countries reached a unanimous agreement in 1998 for the future rules for disposal of petroleum installations.[4] The vast majority of existing offshore installations will be re-used or returned to shore for recycling or disposal. Exceptions are made for certain installations or parts of installations in the event that an overall judgment in each case gives good reasons for sea disposal. For those installations where there is no generic solution, one should take a case-by-case approach, and considerable discretion rests with local

(continued on page 22)

* Petter Osmundsen and Ragnar Tveterås are with Stavanger University College, and are affiliated with Foundation for Research in Economics and Business Administration in Bergen. We are grateful to Frank Asche, Håkan Eggert, Ove Tobias Gudmestad, Rögnvaldur Hannesson, and participants at seminars at the Norwegian Petroleum Directorate, the University of Tromsø, and the Norwegian School of Economics and Business Administration for useful comments and suggestions. We thank The Norwegian Research Council for funding. The paper is an abridged version. The full text can be obtained from the authors at the email address below. Address of correspondence: Petter Osmundsen, Stavanger University College, Section of Petroleum Economics, PO Box 2557 Ullandhaug, 4091 Stavanger, Norway Tel. +47 51 831568. Fax +47 51831550. Email: Petter.Osmundsen@tn.his.no. Internet: http://www.snf.no/Ansatt/Osmundsen.htm

[1] See footnotes at end of text.

governments.

The negative existence value in the population of obsolete offshore oil installations may be one of the elements influencing the reputation costs associated with decommissioning. Reputation is often viewed as a strategic resource for the individual holder, as a positive reputation may provide the holder with goodwill capital. If a country's - or company's - decommissioning policies lead to a reduction in goodwill, other countries' public opinion, special interest groups and governments may become less tolerant of its actions in other areas, and may even introduce direct reprisal actions in the form of public protests, boycotts or court actions. The Brent Spar and Exxon Valdez incidents are two cases where the oil companies involved seem to have perceived the reputation costs to be considerable and have been willing to incur extra costs to reduce these (SNF, 1998, chapter 4).

Norwegian Decommissioning Policies

The Norwegian Parliament sanctioned the OSPAR Convention. However, there is a number of large installations on the Norwegian continental shelf for which decommissioning is not regulated directly by the Convention. Concrete installations and steel jackets with weight above 10,000 tonnes are exempt from the OSPAR ban on sea disposal. For concrete installations, the Norwegian government has full discretion, i.e., they may be fully or partly removed, left in place, toppled on site for use as artificial reef, or dumped elsewhere.[5] The Norwegian government also has partial discretion with respect to decommissioning of the six largest permanent steel installations on the Norwegian continental shelf[6], i.e., the jacket may be left on the seabed but not dumped elsewhere.[7] After February 9, 1999, however, all new steel installations must be designed so that total removal is feasible.

Characteristic features of the Norwegian continental shelf are great deeps and large reservoirs, developed by large installations. Thus, the cost of decommissioning in the Norwegian sector is on average considerably greater than in the rest of the world. There are approximately 6,500 offshore oil and gas installations in the world, with an estimated overall removal cost of 20 billion USD. Decommissioning all of the Norwegian installations was in 1993 estimated to cost 7.5 billion USD, i.e., as much as 37.5 per cent of the estimated global costs.[8] Such estimates are highly uncertain, though. There is not much experience in this field; the first Norwegian decommissioning plan was issued in 1994. New technology and the development of a decommissioning industry are likely to bring down removal costs. Thus, an estimate from 1995 was 5.4 billion USD for a total removal of all installations, and 1.8 billion for a partial removal.[9] The total investments on the Norwegian continental shelf at that time, in comparison, were 100 billion USD. Nevertheless, adding the fact that the Norwegian government will carry most of the costs, and that the major part of these costs will come in a period when petroleum revenues are declining and the number of retirees is increasing, decommissioning will be a considerable fiscal burden for Norway. By establishing a considerable petroleum fund, however, the Norwegian authorities should have the means to smooth out this effect.

The procedures for decommissioning decisions are as follows. The license owners, represented by the operator, develop a detailed decommissioning plan. The plan is to examine and evaluate different decommissioning options. It has a conclusion, which can be perceived as an application for the licensees' preferred decommissioning option. Thereafter, the plan is submitted to the government and at the same time circulated to a number of environmental and fisheries organisations for comments. The plan is then reviewed by the Ministry of Petroleum and Energy, which considers environmental, technical, economic and resource aspects. Furthermore, the ministry considers international obligations and the consequences for fisheries and shipping, and the comments of environmental and fisheries organisations. Typically, the recommendation from the Ministry to *Stortinget* (the Norwegian parliament), lies somewhere between the recommendations from the licensees and the environmental and fisheries organisations. The latter typically advocate a complete removal of all installations, whereas the former would often prefer some of the facilities to remain on the field or to be dumped. The Ministry would recommend only special facilities, such as pipelines, to remain ashore. In these recommendations to Stortinget it is emphasised that each field is unique and that the recommendations are not intended to form precedent. Existing Norwegian offshore petroleum installations are very heterogeneous with respect to factors influencing decommissioning, such as external effects and removal costs, calling for a separate evaluation of each case.

Tax Treatment of Decommissioning

Decommissioning raises some interesting tax questions. As a background for this discussion we first present the general features of the Norwegian petroleum tax regime. The Norwegian petroleum tax system is based on the Norwegian rules for ordinary corporate tax, charged at 28 per cent of corporate profit. Owing to resource rents a special tax of 50 per cent has been added to this industry, implying a marginal corporate income tax of 78 per cent.[10] Licences are allocated by a discretionary licensing system, with no up front payments by the companies. Statoil, a 100 per cent state-owned company, operates on the Norwegian continental shelf on a commercial basis. Through the State's Direct Financial Interest (SDFI), the Norwegian government is a passive stake-holder in many licences.[11] In addition, the Norwegian state owns 40 per cent of Norsk Hydro, a central actor on the Norwegian continental shelf.

As for tax treatment of decommissioning expenses, should (a) the oil companies be allowed appropriations in the tax accounts for future removal costs, or (b) should the actual removal costs be tax deductible? Neither is the case in the Norwegian Petroleum Tax Code. Instead, the state's share of the removal costs is paid directly to the oil companies at the time of removal. These levies are individually sanctioned by the Norwegian Parliament. The main rule for the state's share, estimated in each separate case, is the average effective corporate income tax rate the company has faced on the net incomes from the field. The cost-sharing rule is thus mimicking the tax effect of scheme (a). If the oil company has been in a tax paying position in the entire period of operation, the state's share is approximately 78 per cent. For the decommissioning of 15 platforms at the Ekofisk field, starting in 2003, the state is to pay about two thirds of the removal costs.[12] There are, however, exceptions to this cost sharing

rule. In cases where the estimated state share is unreasonably low, the state's share can be increased, after application by the operator. For the Nordøst-Frigg field the state's share was increased from 39.7 to 50 per cent after application. Exxon applied for increasing the state's share to 68 per cent, up from 38.2 per cent according to scheme (a), and was granted 50 per cent.[13] In calculating the revised cost share, the government has taken into account the company's *future* tax position in Norway[14], i.e., scheme (b) is applied. Thus, while the main rule is (a), rule (b) may be applied if the main rule is unreasonable. Although the tax treatment of decommissioning costs does not convey advantageous tax credits, it does seem to provide the oil companies with a higher probability of obtaining a tax deduction than is the case for other costs.

According to a proposition bill from the Norwegian government (Ot.prp. no. 33, 1985-86), there are several reasons why removal costs are given a special tax treatment. One objective is to avoid discrimination. With a traditional tax treatment, a number of firms would not have had a full tax deduction, since at the time of removal they may not have had sufficient income generated in Norway to cover the costs. Another important objective is to avoid distortions in the companies' decisions, in particular distortions that reduce the recovery rate. Traditional tax treatment of removal costs might tempt the firms to close down production early, while they have sufficient revenue, and refrain from building out adjacent reservoirs (satellite fields).

Another reason why the oil companies were not allowed appropriations in the tax accounts for future removal costs, was perhaps the fact that this approach might imply large tax advantages for the oil companies: because neither the timing nor the extent or costs of future removal could be established with a reasonable degree of certainty at the time of appropriations, these would be arbitrary. Implicit in this argument is the belief that the companies would have an incentive to exaggerate future removal costs, e.g., by underestimating the expected cost reductions due to advances in technology, and thereby obtain undue tax credits.

In addition to refunding parts of the companies' share of the removal costs, the Norwegian state would also have to carry the costs that accrue to the state equity share in the various licences. Assuming that the private oil companies in a given licence have been in a tax paying position for the entire period of operation, and that the SDFI holds 30 per cent of the licence, Statoil 20 per cent, and Norsk Hydro 15 per cent, the Norwegian state is to pay 90 per cent of the removal costs.[15] If Statoil and SDFI together held 80 per cent of the equity (which is the case for some licences), the state would be accountable for 97 per cent of the removal costs.[16]

Externalities to Fisheries from Oil Installations.

In several areas around the globe, such as off the Norwegian coast, the most important externalities from offshore petroleum installations are to the fishing industry. Offshore oil activities have made considerable fishing areas inaccessible for fishing vessels. Hence, the disposal choice for obsolete installations may have significant economic consequences to fisheries. This section analyses the nature of externalities to fisheries, and provides estimates from a case study of the Ekofisk field on the Norwegian continental shelf.

Offshore petroleum installations and pipelines occupy considerable areas in the Norwegian sector that were previously used as fishing grounds or represent potential fishing grounds. Most oil installations have a safety zone that is closed to fishing vessels. Pipelines on the seabed have a reputation for damaging demersal trawl gear (Soldal *et al.*, 1997). In addition, a large number of objects have been dumped on the seabed in conjunction with oil activities, leading to damage or loss of fishing gear.

For both the fisheries and petroleum sector most of the production is exported. In 2000 exports of products from the seafood sector totalled US$ 3.4bn. This is much less than the export revenues of US$ 28.8bn from the petroleum sector. But unlike the latter sector, fisheries should be able to maintain income streams around the current levels into an indefinite future. The Norwegian fishing industry employed 22,900 fishermen in 1997, while 16,000 were employed offshore and onshore in petroleum extraction. However, the greater short-term magnitude of petroleum revenues may have lead to a favourable treatment of the petroleum sector in areas where the two sectors have had conflicting economic interests.

There exist no estimates of the total costs to fisheries due to loss of access, damages to equipment and pollution in the Norwegian sector. A government report from 1986 analyses losses to fisheries for some selected areas (NOU, 1986:6). It estimates the reduction in annual catch revenues due to petroleum activities to represent 23% of the catch potential in these areas, or nominal 1986 US$ 3.3 million. The estimated losses are of minor significance, both in absolute terms or when compared to total revenues from the Norwegian fishing sector. However, with a gradual shift in petroleum activities from the southern waters of the Norwegian sector to the northern waters, where fish resources are much larger, the trend is that new petroleum installations are located closer to the more important fisheries.

Until recently, the focus has been on the effects of new production facilities on fish stocks and fisheries. However, as some oil fields now approach their terminal phase the focus is shifting towards disposal options for installations. An important topic is the potential externalities associated with different disposal options. Although petroleum activities are generally being regarded as a source of negative externalities to the fisheries sector, it is recognized by some that there may be benefits from installations that have reached their cold phase. There are several issues that need to be considered in an analysis of externalities to fisheries from abandoned installations:

- *Stock pollution*: are there any toxic emissions from abandoned installations that can lead to increased mortality and/or reduction in the market value of the fish?
- *Stock enhancement effect*: does the physical presence of oil installations increase the reproductive ability of fish stocks (fishing reefs), thus leading to an increase in fish biomass and harvesting potential?
- *Stock concentration effect*: will the fish stocks gravitate towards the feedstock that tends to gather around offshore installations?
- *Fishing access*: to what extent does the physical presence of obsolete installations and pipelines limit the accessibility of different types of fishing vessels and different gear types?

(continued on page 24)

Issues of Decommissioning *(continued from page 23)*

There is no general answer to the question whether abandoned oil installations will pollute the surrounding fish population. However, it is anticipated that for the installations in the Norwegian sector the costs associated with cleaning up after termination of production should be relatively small. The most visible pollution is usually pile cuttings on the seabed (Anon., 1999). The environmental impact has not been such that it has affected the prices of fish caught in the area.

Summary and Conclusions

This paper has examined major policy issues associated with decommissioning of petroleum installations, using the Norwegian continental shelf as a case study. Decommissioning is becoming an increasingly important issue, as many offshore petroleum fields around the world are approaching the time when their reservoirs are exhausted. The Brent Spar incident suggests that this is also a politically potent issue extending across national boundaries. International conventions, most notably the OSPAR agreement, still allow for a large degree of discretion on the part of national governments in the case of pipelines and large installations.

By signing international agreements such as the OSPAR, governments have constrained themselves to choosing decommissioning options with limited adverse environmental effects. The costs of decommissioning programs depend on the choice of strategy. However, the decommissioning strategy not only influences costs but also which parties are going to carry the costs. Potential winners and losers are oil companies, taxpayers, and different groups of fishing vessels. Hence, decommissioning is a cost-benefit problem involving important distributional considerations, with binding political constraints represented by the national and international environmental opinion, as well as taxpayers' willingness to pay for a clean seabed.

Disposal of petroleum installations raises a number of interesting questions. Examples are timing issues, tax treatment, and liability for installations that are permanently left at the seabed. New technology and discovery of new reserves in adjacent areas may make it optimal once again to use the facilities for extraction purposes. Thus, it may be optimal to postpone the disposal of platforms.

Petroleum installations may function as artificial reefs that may provide positive fish stock concentration and enhancement effects, generating possible gains to specialized artificial reef fisheries but losses to demersal trawlers that will not be able to access the area. Calculations from the Ekofisk field at the Norwegian continental shelf show that leaving the installations as artificial reefs and establishing a marine reserve around the abandoned installation, is the option that generates the highest net present value to the fisheries. However, the future discounted net revenues for fisheries are small, less than one per cent of the disposal costs.

The most influential Norwegian fisheries organization opposes artificial reefs. Adding the fact that environmental organizations strongly oppose reef programs, as well as the fact that the Norwegian government previously has not approved such applications, it is perhaps not surprising that the Ekofisk field operator, Phillips Petroleum, proposes to take the steel substructures on the Ekofisk field ashore. This disposal solution is estimated to cost 460 million USD, compared to 100 million USD for artificial reefs. For this decommissioning decision to be in correspondence with society's cost-benefit calculations, the population's willingness to pay for a clean seabed in this particular area must exceed the net loss to fisheries of removing the installations and the cost difference of removing installations, e.g., it must exceed 363.9 million USD in the case of Ekofisk. It is worth noting that Norway has a small population (5 million) and a large number of offshore platforms. In the area surrounding the Ekofisk field there is a low fish density and a small share of the fish biomass is high value species. Thus, other areas on the Norwegian shelf have a considerably larger potential for increase in fish biomass and economic rent through an artificial reef program.

Footnotes

[1] Shell UK requested the international certification, classification and advisory body *Det Norske Veritas* (DNV), to perform a comparative assessment of the proposed options for disposal of Brent Spar (DNV Report No. 970911-0007). The scope of work covered technical feasibility, safety assessment, environmental assessment and price verification.

[2] See section four for a further discussion and references.

[3] In addition, there are national regulations, which reflect the circumstances of the different countries. Since the UK and Norway are the only countries to have installations in waters deeper than 75 metres, only these two countries have developed detailed procedures and guidelines for offshore disposal. Abandonment plans have to be approved by government and the necessary licences obtained.

[4] OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations.

[5] See proposition from the Norwegian government, St. prp no 8, 1998-99.

[6] Two installations on the Ekofisk Field, two on the Oseberg field, and one on the Brage and Heimdal fields.

[7] Provided that there are 55 metres of clear water over the remains to ensure safety of navigation.

[8] See report to the Norwegian government, NOU 1993:25.

[9] See proposition from the Norwegian government, St. prp. no 36, 1994-95.

[10] Although Norwegian petroleum taxation is mainly a profits tax, royalty is payable on oil production from fields approved for development before 1986, and recently a carbon tax has been imposed on petroleum that is burnt and on gas that is directly released. It has been decided, however, that the royalties will be phased out over a three-year period. Also, the CO_2-tax is likely to be reduced.

[11] For more details on the Norwegian petroleum tax system, see MPE (1998).

[12] *Stavanger Aftenblad*, October 22, 1999.

[13] See proposition from the Norwegian government, St. prp. no. 50, 1995-96.

[14] See St. prp. no. 36, 1994-95

[15] Note that if the companies have partly been out of a tax paying position, e.g., with an average tax rate of 30 per cent, the state's share would be considerably lower.

[16] The state's equity share, however, has been reduced in recent licensing rounds.

References

For references contact the authors.