European Commission
Directorate-General Energy and Transport

Oil Tanker Phase Out and the Ship Scrapping Industry

A study on the implications of the accelerated phase out scheme of single hull tankers proposed by the EU for the world ship scrapping and recycling industry

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Report no.	P-59106-07
Issue no.	1
Date of issue	31st May 2004
Prepared	TOD, MPN, HHU, KWI
Checked	FSL
Approved	TOD, MPN, HHU, KWI

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Executive summary

The study

In July 2003 the European Union adopted legislation accelerating the phasing out of single hull oil tankers. Subsequently, the International Maritime Organisation adopted similar rules affecting potentially all the world fleet of single hull tankers. Following a request of the European Parliament, the European Commission's Directorate-General Energy and Transport has asked COWI A/S to perform the present study "Implications of the accelerated phase out scheme of single hull tankers proposed by the EU for the world ship scrapping and recycling industry". The objectives of the study are directed at clarifying the possible effects of a massive increase in the number and volume of ships destinated for scrapping over few years following the EC Regulation No 1726/2003 and the 2003 IMO amendment to MARPOL Annex 1.

The four main tasks of the study are:

- to estimate the global capacity of ship scrapping based on historic evidence,
- to estimate the consequences of the single hull accelerated phase out on the scrapping industry in terms of future scrapping volume,
- to produce an inventory of facilities applying "green recycling", and
- to describe and discuss the content of the international regulations relevant for the ship scrapping industry and their enforceability.

A key assumption for the study is that proper scrapping of ships is a beneficial activity with respect to sustainability, the provision of work to a significant number of people, and for the provision of steel in the ship scrapping nations. Proper ship scrapping also ensures the sustainable development of the shipping activity as a whole.

On the other hand the present ship scrapping practises in these nations are often violating even basic standards for health, safety and environment.

International and EC regulation on phase out of tankers

In December 1999 a massive oil pollution of the French coast followed the sinking of the single hulled tanker *Erika*. As a result the European Commission proposed to introduce a scheme for phasing out single hull tankers in EU waters with end dates for the operation of single hull tankers similar to those in the US

Oil Pollution Act of 1990 (OPA 90) driven by the *Exxon Valdez* disaster in 1989. After consultations with the IMO, the Annex I of the MARPOL Convention was revised with a phase out scheme less strict than OPA 90 and the EU adopted Regulation 417/2002 making the scheme mandatory.

In November 2002, another single hulled oil tanker, the *Prestige*, sank off Spain resulting in a massive oil pollution of the Spanish coast. The EU Parliament and Council decided immediately to amend Regulation 417/2002, by means of Regulation 1726/03. This amendment aligns *inter alia* the end dates of operation of single hull tankers in the EU oil trades with the relevant dates of the US OPA 90. Subsequently, the IMO decided to amend the phase out scheme of Annex I of MARPOL for all the concerned single hull tankers in the world along the same lines.

Other regulation

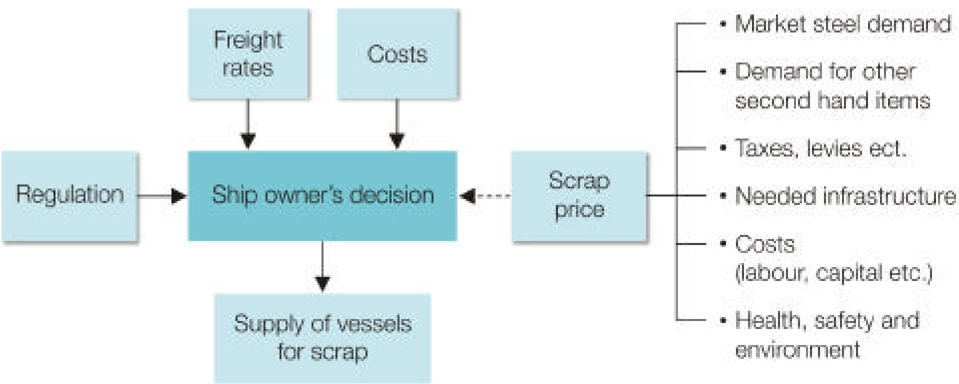
Ships contain hazardous chemicals integrated in their construction, and during operation ships generate various wastes, which in a decommissioning phase will be considered hazardous. The trading of ships for the scrapping industry is therefore subject to the Basel Convention on the "Control of Transboundary Movements of Hazardous Wastes and their Disposal" being the most important (implemented in EU as the "Waste Shipment Regulation" currently under revision). Several cases are described in this report where the convention and national regulation have been applied on end-of-life vessels and ships for scrap. It is however also a fact that the international regulation, with relative ease, can be evaded by the actors involved in trading ships for scrap.

Ship scrapping economics

The economics of the ship scrapping industry and the forces behind demand and supply on the ship scrapping market are interrelated with three other markets that ship owners operate on: the newbuilding market, the second-hand market and the freight market. To some extent the ship scrapping market serves as a buffer balancing demand and supply in the freight market with increase scrapping when the global demand for sea transport moderates.

Key drivers

The key drivers for a ship owner's decision to scrap are outlined in the figure below.



Freight rates appear to be the most important driver for the ship owner's decision on when to supply vessels to the ship scrapping industry. Furthermore, the costs of keeping the vessel in operation (including the 5th special survey of vessel more than 25 years old) and regulatory issues, as for instance phase out schemes, are important regulators for the supply of vessels to the ship scrapping industry. On the other hand the supply of vessels to ship scrappers is relatively inelastic to the price offered by the ship scrapper. Only under extreme circumstances the price offered may influence the volume of scrapping.

Scenarios analysed

The main analysis and assessment is based on two scenarios for phase out of single hull oil tankers:

1 The Base Scenario where the main phase out peak is in 2015 (the 2001 amendments to Annex 1 of MARPOL as implemented in EU by EC 417/2002).

2 The Accelerated Phase out Scenario with peak phase out in 2010 (EU Regulation 1726/2003 and the IMO amendments to Annex 1 of MARPOL in December 2003).

Analysis

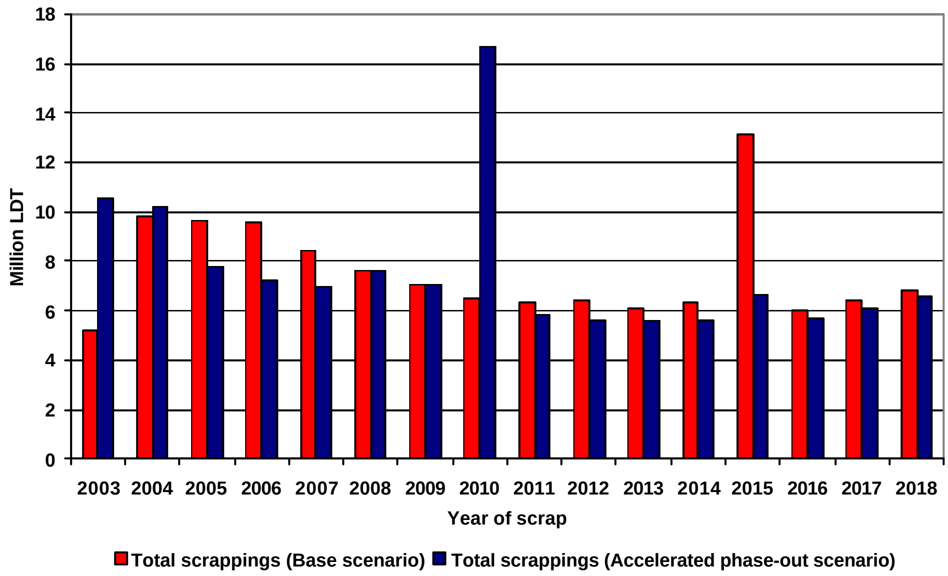
The analysis of the future volumes of decommissioning is separated into two parts: single hull oil tankers and "other shipping segments". Various scenarios and sensitivity analyses are carried out to estimate the sensitivity of the results to the assumptions made.

The new EU and IMO regulations stipulate a more strict regime of surveys of ageing single hull tankers (reinforced CAS), which may lead to scrapping poorly maintained single hull vessels in advance of the final phase out date. Furthermore, some single hull tankers could continue operation in non-petroleum oil trades (i.e. the phasing out applies only to vessels carrying crude oil and oil petroleum products). The possible impact of the stricter control regimes and of possible alternative trades are considered within possible alternative scenarios (sensitivity analysis).

Projected future scrapping volume

For the main analysis, it is estimated that the impact of the accelerated phase out scheme could lead to a peak volume of scrap in 2010 of up to 16.7 million LDT, which is around 25-30% higher compared to the estimate of the peak volume of 2015 for the MARPOL 13G regulation. Of the estimated 16.7 million LDT the single hull oil tankers is estimated to account for 11.0 million LDT. In non-peak years, tankers account for approximately 0.5 million LDT of the total scrapping volume of around 6.5 million LDT.

The estimated phase out volumes for the main analysis is illustrated in the figure below. The figure includes all vessels both tankers and other vessels.



The total fleet of single hull tankers of 5,000 DWT and more represented about 2,256 vessels or 129.5 million DWT (January 2004) and with a number of limited exceptions, these tankers will be withdrawn by 2010 and 2015 in accordance with the stricter timetables of the newest EC and IMO regulations. For the old single hulled tankers (Category 1), a difference exists between the phase out date under EU (2003) and IMO (2005) regime. These tankers (35 million DWT, approx. 500 vessels) are phased out in 2003 and 2004 in the analysis.

Table 1 Estimated number of oil tankers to be phased out for IMO Category 2 and 3, their hull type and year of phase out under the new EC and IMO regulations

Phase out year	Category 2, numbers			Category 3, numbers			Total, numbers
	DB/DS	Single skin	CAT 2 total	DB/DS	Single skin*	CAT 3 total	
2006	-	-	-	22	35	57	57
2007	-	-	-	56	51	107	107
2008	32	71	103	20	23	43	146
2009	26	50	76	30	23	53	129
2010	39	429	468	67	249	316	784
2011-2014	21-24	-	21-24	9-19	-	9-19	30-43
2015	67	-	67	42	-	42	109

Notes: DB/DS designates the vessels with protectively located segregated ballast tanks (double bottom or double side).

*Included in this category are vessels not assigned to category in registers.

Accordingly, the accelerated phase out of single hull oil tankers both in EU (Regulation 1726/03) and globally (revision of MARPOL Annex I) will have a significant impact on the tonnage and number of ships to be scrapped with a major peak now expected in the year 2010 compared to previously 2015.

Effect of assumptions and simplifications

A number of simplifications and assumptions are made for the main analysis. One of the most important is that the EU Regulation 1726/2003 came into force in October 2003 whilst the new MARPOL rules will apply only as of April 2005. These regulations are set equal and apply world wide as one common scenario.

In the IMO regulation exemptions from the phase out dates are allowed if certain conditions are fulfilled, e.g. Condition Assessment Scheme, bilateral agreements between Parties, or the use of the tanker for various other purposes. Several other factors (scrapping prior to the dates specified in the regulation, reshuffling of other types of vessels) are likely to diminish the "peak effect" of the accelerated phase out scheme for single hull oil tankers, but the effects are subject to large uncertainties. In these cases the assumptions used have been determined to reflect the "worst case" to have an output with a clear cut.

Also, the new EU and IMO regulations provide for a banning of carrying heavy grades of oil in single hull tankers. The possible impact of these banning provisions is not examined in the present study.

It is anticipated that the peak in 2010 could become as "low" as 10 million LDT. Even this "low" estimate is, however, considerably, higher compared to the level of scrapping seen historically. During the last 10 years scrapping volumes have fluctuated between 3.0 million LDT and 6.4 million LDT.

Scrapping capacity

Today most vessels and tonnage are scrapped by the beaching method, where the ship is sailed onto a tidal flat at high tide at its own power. The demolition is performed at low tide using manual labour. The major part of beach scrapping takes place in Turkey, Bangladesh, Pakistan and India. China is also active in the demolition market, but here the vessels are typically moored along side a quay and more heavy equipments such as cranes are involved (pier breaking).

Demolition of beached vessels in Asia (copyright, ILO)

The present capacity to meet the phase out demand is found in the developing countries where the scrapping industry is located, and the historical recorded scrapping volumes show a mean annual scrapping volume in the years 1994-2003 of 4.7 million LDT with a maximum of 6.4 million LDT in 1999. The predicted future scrapping volumes are considerably higher, but the study concludes that there is no historical evidence of capacity constraints in the industry. The quantity processed by the industry at any time is merely reflecting the supply of vessels. Thus, if the future ship breaking is to be carried out under the present conditions governing the industry in Asia, it may be expected that the demand for scrapping capacity can be met.

Asian ship breaking workers (copyright, ILO)

Recycling guidelines

Considerable international focus has been directed towards the ship scrapping industry due to concerns for the environment, workers' health and safety issues. As a result of this, several guidelines for ship recycling have recently been developed and adopted in the context of the IMO, the Basel Convention and the ILO respectively. Until now the guidelines have had little impact on improving the working and health conditions in countries where the ship recycling industry is concentrated.

In addition to the above mentioned guidelines, a preliminary Industry Code of Practice on Ship Recycling has been prepared by industry organisations in the context of the Marisec and a set of guidelines for ship scrapping in the United States has been developed by the United States Environmental Protection Agency.

"Green recycling"

Only a few scrapping facilities claim to perform ship recycling in an acceptable way in relation to the environment and workers' health and safety. Green recycling is ideally defined as scrapping performed in full accordance with the developed recycling guidelines. For the purpose of this study, the world market has been scanned and green ship recycling facilities have been identified based on the facilities own statements (homepages, interviews etc.), third party evaluations and other volunteered information. It has been beyond the scope of the study to evaluate, inspect or audit the dismantling procedures/facilities for compliance with the recycling guidelines.

Green recycling capacity

The identified existing green recycling capacity for larger tankers is limited and may only in an optimistic interpretation reach around 780,000 LDT/year. As seen in the table below most of this capacity is found in two yards in China, where a limited number of vessels have been scrapped according to guidelines, but the listed annual capacity has not yet been utilised for green recycling.

Country	Existing green recycling capacity LDT/year
Italy	80,000
Belgium	120,000
Holland	30,000
China	550,000 *
USA	N/A
Total	780,000

*: The total yard capacity of two yards that has performed green recycling - not all may be approvable for green recycling

In addition to the existing green recycling facilities a number of planned green facilities, or under establishment, have been identified. The planned capacities of these facilities totals around 1.1 million LDT/year, which, together with a planned extension at the Jiangyin yard in China, can bring the annual green recycling capacity up to around 2 million LTD within a few years. This capacity accounts for around 30% of the predicted total scrapping demand in most years, and much less in the peak demand years.

Pier braking of vessel, Spain (COWI A/S)

Keel to be broken up at Chinese yard (courtesy of T. Blankestijn, P&O Nedl-loyd)

Dormant capacity

The existing traditional ship scrapping facilities are obvious candidates for being upgraded to comply with health, safety and environmental guidelines.

Ship yards engaged in ship scrapping exist in most European countries, but they are typically small and engaged in scrapping of fishing vessels and other small vessels up to 5,000 DWT. Some capacity may be found in these yards by expanding them to cater for the lower size range of tankers.

Dormant green recycling capacity is potentially found in existing ship yards with large dry-docks. There exist more than 80 dry-docks above 60,000 DWT out of which around 30 are in Europe. The facilities engaged in decommissioning of offshore oil/gas-structures may also contribute to capacity and currently six existing and five planned European facilities for decommissioning of offshore structures are found. At the present market conditions these facilities are not expected to enter the ship scrapping market.

Extra costs

The main constraint for the expansion of green recycling is that it is more expensive than the conventional beach breaking. The extra cost for performing green recycling is related to a demand for infrastructure (drainable surfaces, dry dock capacity), and to each of the extra processes involved in green recycling, including:

- Construction costs for new equipment, machinery and infrastructure
- Manpower costs for new and more time consuming work routines
- Hazardous waste disposal costs.

Construction costs for establishment of three green-field green recycling facilities with varying capacity, have been found to be in the range of 67-96 million USD each. The extra manpower cost associated with the new and more time consuming working routines has not been estimated.

Chinese workers, equipped with protective clothing and personal equipment, removing insulation material as part of pre-cleaning (courtesy of T. Blankestijn, P&O Nedlloyd)

The time used for performing cleaning of vessels between 10,000 and 25,000 LDT have been found to range from 4 to 7 weeks, and the cost of performing hazardous waste cleaning of a ship is estimated to be in the range of 25-50 USD/LDT in Asia and slightly higher in Europe. The isolated disposal costs for the hazardous waste onboard a specific 37,500 LDT Very Large Crude Carrier (VLCC) have been estimated at 615,000 - 750,000 USD, corresponding to 16-20 USD/LDT.

EU promotion of green recycling

The challenge for EU - and the Member States - in terms of promoting green recycling is associated to the global nature of the shipping business and the obvious fact that EU can apply rules and regulations only within its jurisdiction. Hence, effective actions from the EU seem to be restricted to:

- Use the presently available capacity of European green recycling facilities and expand the capacity in Europe.
- Upgrade existing dismantling facilities in Third world countries to a green recycling standard.

A brief catalogue of long and short term options for promoting green recycling in EU and in the present breaker countries includes developing improved regulation, economic incentives and awareness raising.

- Mandatory implementation of IMO guidelines in ship scrapping nations.
- Take-back approach for construction yards (long term).
- A global fund fuelled with levies from the shipping industry to finance scrapping of the individual vessel (long term).
- Support to the green facilities to increase their competitiveness, e.g. R&D, technical assistance, procurement of equipment.
- Subsidies, tax benefits etc. to ship owners using green recycling.
- Inclusion of the issue in bilateral agreements with relevant countries to bring attention to the matter.
- Technical assistance to the development and implementation of national roadmaps to improved conditions in breaker yards.
- Assistances to shipping industry, e.g. with development of certification/auditing activities for green recycling facilities and lists of approved facilities.

The possibilities exist for a green recycling capacity to be developed, but the lack of legal and economic incentive for establishing a large scale green recycling capacity for the global market is evident in the ship scrapping industry today.

Conclusions

The conclusions of the study in respect of the four main tasks referred to above are:

- If the future ship breaking is to be carried out under the present conditions governing the industry in developing countries, in particular in Asia, it may be expected that the demand for scrapping capacity can be met. There is no historical evidence of capacity constraints in the industry (Chapter 4 and 5).

- The total fleet single hull tankers of 5,000 DWT and more represented about 2,256 vessels or 129.5 million DWT (January 2004), and it is estimated that the accelerated phase out scheme could lead to a peak volume of scrap in 2010 of up to 16.7 million LDT, which is 25-30% higher compared to the estimate of the peak volume of 2015 for the MARPOL 13G regulation. The single hull oil tankers are estimated to account for 11.0 million LDT. In the non-peak years tankers account for approximately 0.5 million LDT of the total scrapping volume of around 6.5 million LDT (Chapter 6).

- The inventory of facilities applying "green recycling" (i.e. scrapping performed in accordance with the developed recycling guidelines, Chapter 7) is given in Chapter 8. The identified existing green recycling capacity for larger tankers is limited and may only in an optimistic interpretation reach around 780,000 LDT/year.

- The international regulations relevant for the ship scrapping industry are described and discussed in Chapters 2, 3 and 10. During recent years the international focus on the environment and health problems in the ship breaking industry have been raised. As a result of this a set of interrelated guidelines for ship recycling have recently been developed and adopted in the context of the IMO, the Basel Convention and the ILO respectively. However, none of the guidelines are mandatory or legally binding. The challenge for EU - and the Member States - in terms of promoting green recycling is associated to the global nature of the shipping business and the obvious fact that EU can only apply rules and regulations within its jurisdiction.

Preamble

This study was initiated by the Directorate-General Energy and Transport of the European Commission (DG TREN) by 15 October 2003 order No 2003/003-G2. It was required by the European Parliament in the context of the discussion of Regulation (EC) No 1726/03 accelerating the phasing out of single hull oil tankers as a consequence of the catastrophe originated by the loss of the single hull oil tanker *Prestige* in November 2002. It has been steered by the DG TREN in co-ordination with representatives of DG Enterprise and DG Environment.

The study was carried out by the Contractor Kampsax/COWI by a team led by Dr. F. Stuer-Lauridsen. The team comprised Ms. H. Husum (Environmental Law), Mr. M. P. Jensen (Environmental Economics), Mr. T. Odgaard (Shipping) and Mr. K. Winther (Environmental, Health and Safety).

A great number of representatives of Industry, National and International Authorities, NGOs and other stakeholders are thanked for having contributed information to the study.

The views and opinions expressed in the study correspond to the Team of experts that have conducted the study and do not represent necessarily the views and opinions of the European Commission.

Abbreviations and glossary

Abbreviation/ acronym	**Name**	**Explanation**
Ballast		Seawater taken into a vessel's tanks in order to submerge the vessel to proper trim
BIMCO	Baltic and International Maritime Council	Trade organisation representing ship owners, ship brokers and agents, and other members
Bulk Cargo		Usually a homogeneous cargo stowed in bulk, and not enclosed in any container
CAS	Condition Assessment Scheme	Condition Assessment Scheme which stipulate verification of the reported structural condition of the ship and that documentary and survey procedures have been properly carried out and completed
Category 1 tankers		Single hull crude oil tankers of 20,000 tons deadweight and above and single hull oil product carriers of 30,000 tons deadweight and above having no segregated ballast tanks in protective locations (SBT/PL). They are generally constructed before 1982
Category 2 tankers		Same size as category 1 tankers, but equipped with (SBT/PL) and provide therefore greater protection against grounding and collision. They are generally constructed between 1982 and 1996
Category 3 tankers		Single hull oil tankers below the size limits of categories 1 and 2 but above 5,000 tons deadweight
Deadweight, DWT	Dead Weight Tonnage	The lifting or carrying capacity of a ship when fully loaded. The deadweight is the difference, in tonnes, between the displacement and the lightweight. It includes cargo, bunkers, water (potable, boiler, ballast), stores, passengers and crew
Decommission		The decision and process of taking a ship out of service
Demolition		The process of taking a ship apart, including beaching.
Dismantle		The physical process of taking the ship apart, not including beaching
EU Member states		European Union member countries as of January 1 2004
New EU Member States		The 10 countries entering the EU May 2004
EU accession countries		Includes Bulgaria, Romania and Turkey
DT	Displacement Tonnage	Expressed in tonnes it is the weight the water displaced by

		the vessel which in turn is the weight of the vessel at that time
Gas free	Gas free (for hot work)	Gas Free Certificate - A certificate stating that the air in a tanker's (empty) cargo tanks is safe
GT	Gross Tonnage	The internal capacity of a vessel measured in units of 100 cubic feet
ICS	International Chamber of Shipping	The international trade association for merchant ship operators
ILO	International Labour Organisation	The UN agency seeking the promotion of social justice and internationally recognized human and labour rights
IMO	International Maritime Organisation	The United Nations' agency responsible for improving maritime safety and preventing pollution from ships
LDT	Light displacement tonnes or Lightweight	The lightweight is the displacement, in t, without cargo, fuel, lubricating oil, ballast water, fresh water and feed water, consumable stores and passengers and crew and their effects, but including liquids in piping
MARAD	Maritime Administration	US Department of Transportation Authority
MARPOL		International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)
MARPOL tankers		Category 2 tankers according to MARPOL 73/78
MEPC	Marine Environment Protection Committee	IMO's senior technical body on marine pollution related matters
OPA 90	Oil Pollution Act of 1990	US EPA Oil Pollution Act of 1990 on prevention of and responding to catastrophic oil spills
Panamax.		The maximum size ship that pass through the Panama Canal in terms of width, length and draught; generally about 80,000 DWT
Pre-MARPOL tankers		Category 1 tankers according to MARPOL 73/78
Recycling	Green recycling	The process of taking a ship apart, when procedures to safeguard the environment, workers' health and safety are applied - "green recycling"
SBT/PL	Segregated ballast tanks in protective locations	Ballast tanks positioned where the impact of a collision or grounding is likely to be greatest
Scrapping		"Neutral" word for the process of taking a ship apart without considering the procedures used
Ship breaking		The traditional process of taking a ship apart, including beaching
ULCC	Ultra Large Crude Carrier	Tanker of 320,000 DWT & above
US EPA	United States Environmental Protection Agency	United States Government Environmental Authority
VLCC	Very Large Crude Carrier	Tanker of 200,000-320,000 DWT

1 Introduction

1.1 Context

Since the environmental catastrophe originated by the sinking of the *Exxon Valdez* in Alaska in 1989, there has been a growing concern about the suitability of the single hull oil tanker design to prevent maritime accidents. A phase out scheme for single hull oil tankers was first introduced with the US Oil Pollution Act of 1990 (US OPA 90). In 2000 the single hull tanker Erika was lost off the coast of Brittany, France, spilling some 20,000 tonnes. Subsequently, the International Maritime Organisation introduced a phase out scheme for single hull tankers at international level. The IMO phase out scheme was, however, less ambitious than the scheme of the US.

In 2003, after the catastrophe originated by the loss of another single hull oil tanker, Prestige, off the Galician coast, Spain, the EC adopted a Regulation introducing at European level a phase out, which speeds up the phase out scheme in alignment with the US OPA 90 Scheme. Subsequently, upon a proposal of the EU Member States, the IMO decided to introduce a similar acceleration of the phase out of single hull oil tankers at world-wide level.

The accelerated elimination of the world fleet of single hull oil tankers risk having a significant impact on the market for ship scrapping. Taking into consideration the growth of the world fleet of all types of ships over the last 30 years and an equal but timely delayed growth of ship scrapping volume, the new phase out regulations introduce a risk for the ship scrapping market being flooded.

Ship scrapping is one of four integrated markets and part of the shipping business, each trading different kinds of products/services:

- The newbuilding market trades new vessels
- The freight market trades sea transport services
- The sale and purchase market trades second-hand vessels
- The scrapping market trades old and obsolete vessels.

The ship scrapping industry of today is associated with a dilemma from an environment, health and safety point of view. On one hand the industry provides what a responsible business area to should, namely a way to make sure that the assets are recycled; to consider the end-of-life products as resources. On the other hand the majority of the industry with its existing practises has gained a reputation for violating basic concerns of environment, health and safety. Thus, ship scrapping as a business is in compliance with a sustainability approach, but not under the current practices.

1.2 Objectives

The study

The present study is concerned with the ship scrapping industry and the particular supply of ships from the phase out schemes of single hull oil tankers. The study aims at:

- Estimate the global capacity of ship scrapping based on historic evidence
- Project the consequences of the single hull advanced phase out on the scrapping industry in terms of future scrapping volume
- Produce an inventory of sites applying "green recycling"
- Describe and discuss the content of the international regulations relevant for the ship scrapping industry and their enforceability.

Global capacity for scrapping ships

The possible developments of the market for decommissioning of ships is analysed and key drivers discussed, based on historical data and relevant available studies addressing the development of capacity for scrapping ships.

Projection of the volume of ship scrapping

The future supply of vessels for scrap is projected up till year 2015 taking into account the new single hull phase out requirements. The two main scenarios which are mentioned below are supplemented with a number of sensitivity analyses:

- Base scenario, which is the MARPOL 13G as revised in 2001 and implemented in EU by EC 417/2002.
- Case scenario, which is the accelerated phase out according to EC 1726/2003, which again in practice equals the MARPOL 13G as revised December 2003.

Green recycling

The possibilities for carrying out ship dismantling under controlled and acceptable conditions regarding workers health, safety and environment, e.g. according to recently approved IMO procedures is evaluated.

International regulation

The regulation regarding single hull tanker phase out and other regulation influencing the ship scrapping industry is described. Problem areas in the current regulation on regulating shipment of end-of-life vessels are outlined.

Examples of cases of ships destined for scrapping being detained in the EU or denied entry for reasons of hazardous waste concerns are presented.

Possible future EC initiatives

Based on the results of the study possible future EC initiatives towards development of the ship scrapping industry will be discussed. Recommendations will be made for possible future initiatives by EC towards the ship scrapping industry.

1.3 Definitions

The present study applies the following definitions for the words related to describing the processes of taking an obsolete vessel out of service, taking it apart and disposing of or recycling the resulting material.

Word	Definition
Decommission	Taking an end-of-life ship out of service
Dismantle	The physical process of taking the ship apart, not including beaching
Demolition	The process of taking a ship apart, including beaching
Ship breaking	The process of taking a ship apart, including beaching
Recycling	The process of taking a ship apart, when procedures with respect for the environment and workers health and safety are applied, "green recycling"
Scrapping	"Neutral" word for the process of taking a ship apart without considering the procedures used

2 International regulation

This section provides an overview of the international and EU regulation on the phase out of single hull tankers, focussing on their scope of application and the phase out timetables.

The international and EU instruments relevant for ship recycling, including three guidelines recently adopted by the IMO, ILO and the Basel Convention, respectively, are also presented.

Finally, initiatives and trends relating to existing and planned international instruments are summarised.

The impact of international and EU regulation on the world scrapping industry is examined in more detail in the subsequent sections.

2.1 Regulation of phase out of single hull tankers

2.1.1 Overview of the regulation and its background

The phase out of single hull oil tankers has been on the maritime safety agenda for a number of years.

The US Oil Pollution Act of 1990

Subsequent to the grounding of the oil tanker *Exxon Valdez* in 1989, the U.S. introduced the Oil Pollution Act of 1990 (OPA 90) which included provisions for the double hulling of oil tankers. OPA 90 required new oil tankers to be double hulled and established a phase out scheme for existing single hulled tankers. New oil tankers under OPA 90, included those built after 1990, but for tankers already on order it also included tankers delivered up to January 1, 1994. Older single hulled tankers were phased out starting in 1995 and the final date for phase out of all single hulled tankers is 2015. The phase out of any particular single hull tanker was based upon its year of build, its gross tonnage and whether it had been fitted with either double bottoms or double sides.

OPA 90 may have had an impact on the volume of single hull tankers sent to scrap. However, this impact is considered to be limited, in so far as the main effect of the US regime has been to divert the use of single hull tankers towards other world regions (i.e. non US oil trades).

Amendment to Annex 1 of MARPOL in 1992

International requirements for the double hulling of oil tankers were introduced by the International Maritime Organization (IMO) in 1992 through an amendment to Annex I of MARPOL73/78[1]. This amendment also required new oil tankers to be double hulled and existing single hull tankers to be phased out, but the phase out time tables were not identical to the OPA 90 scheme. New oil tankers under MARPOL included those built after 1993, but for tankers already on order, also included tankers delivered up to 1996. The phase out of existing tankers under MARPOL applied only to large tankers (product tankers over 30,000 DWT and tankers over 20,000 deadweight tonnes carrying crude oil, fuel oil, heavy diesel oil or lubricating oil as cargo). Older large oil tankers were phased out starting in 1995 and the final date for phase out of all large single hulled tankers was 2026. The phase out of any particular large single hulled tanker was based upon its year of build and whether or not it was fitted with approved segregated ballast tanks[2]. Large single hulled tankers shall be phased out when they are 25 years old if they are not fitted with segregated ballast tanks, or when they are 30 years old if they are fitted with segregated ballast tanks. MARPOL also accepts the use of hydrostatic balanced loading or other approved alternatives as equivalent to double hulling.

The 2001 Amendment to MARPOL and EC Regulation 417/2002

Back in 2000, following the sinking of the *Erika*, the Commission proposed to introduce a phase out scheme for single hull tankers similar to the US OPA 90. The EU Member States decided to discuss the matter at the IMO first. The outcome was the 2001 revised regulation 13G, with a phase out scheme less strict than the OPA 90. Subsequently, the EU adopted Regulation 417/2002.

EC Regulation 1726/2003 amending Regulation 417/2002

In December 2002, following the sinking of the *Prestige*, the Commission proposed to accelerate the phase out scheme approved in 2001 to align it with the relevant phase out dates of the OPA 90. This time, the EU Member States decided to amend Regulation 417/2002 (by means of Regulation 1726/2003) first and thereafter refer the matter to the IMO.

- the accelerated phase out timetables

With the adoption of Regulation 1726/2003, the European Union has since October 2003 applied rules which are as strict as current US rules for the gradual phasing-out of single hull oil tankers.

Category 1 oil tankers[3] are the most vulnerable and the oldest vessels. They are the so-called "pre-MARPOL" single hull tankers, being crude oil tankers of 20,000 tons deadweight and above and oil product carriers of 30,000 tons deadweight and above having no segregated ballast tanks in protective locations

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[1] The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL73/78), hereinafter referred to as MARPOL.

[2] Tankers without segregated ballast tanks but with wing tanks or double bottoms not used for the carriage of oil and meeting the requirements of 13E(4) of MARPOL Annex I, covering at least 30% of the length of the cargo tank area for the full depth of the ship on each side or at least 30% of the projected bottom shell area with the length of the cargo tank area may be considered as being fitted with segregated ballast tanks.

[3] The three main categories of single hull tankers remain those of Regulation (EC) No 417/2002.

(SBT/PL). They are generally constructed before 1982. The final date for the use of these oil tankers under the Regulation is therefore brought forward from 2007 to 2005 subject to an age limit of 23 years (28 years under the rules previously in force).

Category 2 oil tankers correspond to "MARPOL" single hull tankers, being of the same size as category 1, but which are equipped with SBT/PL and provide therefore greater protection against grounding and collision. They are generally constructed between 1982 and 1996. These tankers will be withdrawn by 2010 in accordance with a stricter timetable.

The same timetable now applies to small, category 3 oil tankers. Category 3 corresponds to single hull oil tankers below the size limits of categories 1 and 2 but above 5,000 tons deadweight. These smaller tankers often operate in regional traffic.

- transportation of heavy grades of oil in single hull tankers prohibited

- special inspection arrangements for oil tankers extended

Furthermore transportation of heavy grades of oil in single hull tankers to or from the ports of a Member State is prohibited with immediate effect and the special inspection arrangements to assess the sound structural state of single hull oil tankers have been extended and will be implemented earlier. All single hull tankers, including the smallest ones which were not initially covered by the scheme, are subject to the Condition Assessment Scheme (CAS) from the age of 15 years. The CAS is an enhanced inspection scheme specially developed to detect structural weaknesses in single hull tankers. Oil tankers which do not meet the test requirements may be refused entry to EU ports or to fly the flag of an EU member state.

Under certain circumstances the EU rules allows for an exception for category 2 and 3 oil tankers to operate, beyond 2010 subject to satisfactory results from the CAS, but not beyond 2015 or the date on which the ship reaches 25 years of age after the date of its delivery, whichever is sooner.

Table 2.1 below contains a comparison of the EU phase out and inspections rules applicable since 21 October 2003 and those applicable prior hereto.

Table 2.1 Comparison of the EU phase out and inspections rules applicable before and after 21 October 2003

Type of tanker/cargo	**EU rules applicable from 2001 to 21 October 2003**	**New EU rules applicable since 21 October 2003**
Heavy grades of oil : heavy fuel oil, heavy crude oil, waste oils, bitumen and tar:		
Single hull tankers of all flags	No rules	Banned from EU ports. All shipments of heavy grade oil to or from EU ports, offshore terminals or anchorage areas to be carried by double-hull oil tankers, regardless of their flag. When : from October 2003 for all tankers, except those between 600 and 5,000 DWT (in their case from 2008)
All grades of oil:		
Single hull tankers of all flags	Banned from EU ports When : age limits between 26 and 30 years with end phase- out being - Category 1 : 2007 - Category 2 : 2015 - Category 3 : 2015	Banned from EU ports When : over age limits between 23 and 28 years of age with end phase out being: - Category 1 : 2005 - Category 2 and 3 : 2010[4] -
CAS compliance:		
Single hull oil tankers of all flags	Needed to enter EU ports When : - Category 1 : 2005 - Category 2 : 2010 - Category 3 : not applicable	Needed to enter EU ports When - Category 1 : not applicable (phased out) - Category 2 : 2005 from 15 years of age - Category 3 : 2005 from 15 years of age

The 2003 Amendment to MARPOL regulation 13G and a new regulation 13H

Following the adoption of Regulation 1726/2003 in February 2003, the EU submitted a proposal to IMO to have these stricter safety standards applied to the entire world fleet through amendments to Annex 1 of MARPOL. In December 2003 IMO adopted a revised, accelerated phase out scheme for single hull tankers, along with other measures including an extended application of the Condition Assessment Scheme (CAS) for tankers and a new regulation

[4] For the tankers which has a strenghten structure: ban from 2015 or 25 years (as in USA legislation).

banning the carriage of Heavy Grade Oil (HGO) in single hull tankers similar to the new EU rules[5].

The revised Annex I of MARPOL provides for a number of exceptions that are not contemplated in the EC Regulation. Thus, e.g., Flag States can exempt oil tankers operating exclusively in regional trades from the phase out regime. Moreover, special provisions are also foreseen for the last generation of single hull tankers (built after 1995) and for tankers fitted with double sides and/or double bottoms. The 25 EU Member States have already announced that they will not make use of those exemptions and that the single hull tankers from countries benefiting from them will not be allowed to operate from/to EU ports.

2.1.2 Scope of application - flag state or geographical

Different approaches to the scope of application of the rules on phase out of single hull vessels are applied internationally and in the U.S. and EU.

Whereas the MARPOL Convention in general only applies to vessels, the flag states of which are Parties to the Convention[6], the scope of the U.S. Oil Pollution Act of 1990 section 4115 is geographical. The prohibition on certain single hull ships thus applies to all vessels operating within the jurisdiction of the U.S. including the Exclusive Economic Zone.

The approach of the EU resembles that of the MARPOL Convention with the addition that not only ships, sailing under the flag of an EU Member State but also any single hull tanker entering or leaving a port or offshore terminal or anchoring in an area under the jurisdiction of one of the EU Member States must comply with the requirements of Regulation 417/2002 as amended by Regulation 1726/2003[7].

2.1.3 Comparison of phase out timetables for single hull tankers

Phase out years for the three categories of tankers according to EC Regulation No. 417/2002 of 18 February 2002, EC Regulation No. 1726/2003 of 22 July 2003 and IMO 13G from 2001 and 2003 are shown in the following three tables.

[5] The amendments to the International Convention for the Prevention of Pollution from ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78) were adopted at the 50th session of IMO's Marine Environment Protection Committee (MEPC) and are expected to enter into force on 5 April 2005, under the tacit acceptance procedure.

[6] According to the Revised Regulation 13G, a Party to the MARPOL Convention are entitled to deny entry of single hull oil tankers into ports or offshore terminals under its jurisdiction.

[7] The scope of application of the EU regulation has been extended by Regulation 1726/2003. Prior to 21 October 2003, the EU regulation only applied to oil tankers of 5,000 DWT and above flying the flag of a Member State or entering a port or offshore terminal under the jurisdiction of a Member State, irrespectively of their flag.

Table 2.2 Phase out years for category 1 tankers

Year	IMO Regulation 13G from 2001 and EC Regulation from 2002[8]	The EC Regulation from 2003[9]	IMO Regulation 13G from 2003
2003	Ships delivered 1973 or earlier	Ships delivered 1980 or earlier	
2004	Ships delivered 1974 and 1975	Ships delivered 1981	
2005	Ships delivered 1976 and 1977	Ships delivered 1982 or later	All ships. Those delivered before 6th April 1982 must be phased out 5th April
2006	Ships delivered 1978, 1979 and 1980		
2007	Ships delivered 1981 or later		

[8] Regulation (EC) No 417/2002 of the European Parliament and the Council of 18 February 2002 on the accelerated phasing-in of double hull or equivalent design requirements for single hull oil tankers and repealing Council Regulation (EC) No 2978/94.

[9] Regulation (EC) No 1726/2003 of the European Parliament and the Council of 22 July 2003 amending Regulation (EC) No 417/2002 on the accelerated phasing-in of double hull or equivalent design requirements for single hull oil tankers.

Table 2.3 Phase out years for category 2 tankers

Year	**IMO Regulation 13G from 2001 and EC Regulation from 2002**[10]	**The EC Regulation from 2003**[11]	**IMO Regulation 13G from 2003**
2003	Ships delivered 1973 or earlier	Ships delivered 1975 or earlier	
2004	Ships delivered 1974 and 1975	Ships delivered 1976	
2005	Ships delivered 1976 and 1977	Ships delivered 1977	Ships delivered 1977 or earlier (5th April for ships delivered before 6th April 1977)
2006	Ships delivered 1978 and 1979	Ships delivered 1978 and 1979	Ships delivered 1978 and 1979
2007	Ships delivered 1980 and 1981	Ships delivered 1980 and 1981	Ships delivered 1980 and 1981
2008	Ships delivered 1982	Ships delivered 1982	Ships delivered 1982
2009	Ships delivered 1983	Ships delivered 1983	Ships delivered 1983
2010	Ships delivered 1984	Ships delivered 1984 or later	Ships delivered 1984 or later
2011	Ships delivered 1985		
2012	Ships delivered 1986		
2013	Ships delivered 1987		
2014	Ships delivered 1988		
2015	Ships delivered 1989 or later		

[10] Regulation (EC) No 417/2002 of the European Parliament and the Council of 18 February 2002 on the accelerated phasing-in of double hull or equivalent design requirements for single hull oil tankers and repealing Council Regulation (EC) No 2978/94.
[11] Regulation (EC) No 1726/2003 of the European Parliament and the Council of 22 July 2003 amending Regulation (EC) No 417/2002 on the accelerated phasing-in of double hull or equivalent design requirements for single hull oil tankers.

Table 2.4 Phase out years for category 3 tankers

Year	IMO Regulation 13G from 2001 and EC Regulation from 2002[12]	The EC Regulation from 2003[13]	IMO Regulation 13G from 2003
2003	Ships delivered 1973 or earlier	Ships delivered 1975 or earlier	
2004	Ships delivered 1974 and 1975	Ships delivered 1976	
2005	Ships delivered 1976 and 1977	Ships delivered 1977	Ships delivered 1977 or earlier (5th April for ships delivered before 6th April 1977)
2006	Ships delivered 1978 and 1979	Ships delivered 1978 and 1979	Ships delivered 1978 and 1979
2007	Ships delivered 1980 and 1981	Ships delivered 1980 and 1981	Ships delivered 1980 and 1981
2008	Ships delivered 1982	Ships delivered 1982	Ships delivered 1982
2009	Ships delivered 1983	Ships delivered 1983	Ships delivered 1983
2010	Ships delivered 1984	Ships delivered 1984 or later	Ships delivered 1984 or later
2011	Ships delivered 1985		
2012	Ships delivered 1986		
2013	Ships delivered 1987		
2014	Ships delivered 1988		
2015	Ships delivered 1989 or later		

2.2 International instruments relating to ship recycling

The international and EU instruments concerning and/or relevant for ship recycling, including three guidelines recently adopted by the IMO, ILO and the Basel Convention, respectively, are presented in the following subsections.

2.2.1 The Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal[14] sets up a control system for transboundary

[12] Regulation (EC) No 417/2002 of the European Parliament and the Council of 18 February 2002 on the accelerated phasing-in of double hull or equivalent design requirements for single hull oil tankers and repealing Council Regulation (EC) No 2978/94.

[13] Regulation (EC) No 1726/2003 of the European Parliament and the Council of 22 July 2003 amending Regulation (EC) No 417/2002 on the accelerated phasing-in of double hull or equivalent design requirements for single hull oil tankers.

movements of hazardous wastes. The system is based on a prior written notification procedure on the part of the exporting state and the requirement of prior written consent from the state of import before any transboundary movement of hazardous wastes can take place. Furthermore, Parties under the Convention are to ensure that hazardous wastes are managed and disposed of in an environmentally sound manner. Hazardous wastes may not be exported to or imported from a non-party country.

In 1995, it was decided to amend the Convention and to ban export of hazardous wastes from what are known as Annex VII countries (Basel Convention Parties that are members of the EU, OECD and Liechtenstein) to non-Annex VII countries (all other Parties to the Convention). The Basel Ban Amendment has not yet entered into force.

As the Basel Convention only applies to hazardous wastes and other wastes as defined in Article 1 (1) and (2) of the Convention, it becomes relevant to determine if and when, an end-of-life ship destined for scrapping is hazardous waste.

A ship may become waste, in accordance with Article 2 of the Basel Convention, and at the same time, it may be defined as a ship under other international rules. Among the Basel Convention Parties, including the EU, it is recognised that the application of the Basel convention to ships and other floating structures is as yet partly undetermined. There have in recent years been a number of cases where the Basel Convention and the EC Waste Shipment Regulation (described below) have been applied to end-of-life vessels and ships for scrapping. Some of these cases have involved court rulings on specific ships to be considered as hazardous waste. These and cases, where shipment of an end-of-life vessel or ship destined for scrapping have been rejected with reference to the Basel Convention or the EC Shipment Regulation are described in Chapter 3.

The more specific criteria, when a ship becomes a hazardous waste as well as different scenarios, are currently being examined the by the Basel Convention Parties. Possible solutions, including clarifying the scope of the Convention are expected to be presented to the forthcoming meeting of the Conference of the Parties in October 2004. Some of these scenarios and possible solutions are further described in Section 2.3.

2.2.2 The EU Waste Shipment Regulation 259/93/EEC

The Waste Shipment Regulation[15] 259/93/EEC determines which procedures to apply before a waste can be shipped within, into and out of the European Community. It is largely based on the Basel Convention on the control of transboundary movements of hazardous waste and their disposal, as amended and

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[14] The Basel Convention was adopted in 1989 and entered into force on May 5, 1992. As of 28 May 2004, 159 and the European Union are Parties to the Basel Convention.

[15] Council Regulation 259/93/EEC of 1 February 1993 on the supervision and control of shipments of waste within, into and out of the European Community, as amended

the OECD Decision C(92)39/final on the control of transfrontier shipments of wastes destined for recovery operations.

Shipments of waste have to follow different procedures and control regimes, depending of the type of waste shipped and the type of treatment that will be applied to the waste at the destination - recovery or disposal. All waste, including end-of-life ships and vessels, destined for disposal and semi-hazardous waste destined for recovery are subject to the requirement of prior written notification and the countries of dispatch, destination and transit have to give their prior consent to the shipment before it can start. They can thus, under certain circumstances, object to the shipment. Furthermore, a notification must be accompanied by a contract regarding the recovery or disposal of the waste and a financial guarantee or the equivalent insurance covering the shipment[16].

It follows from the Waste Shipment Regulation that:

- Exports of ships destined for disposal outside the Community are banned if destined for non-OECD countries
- Exports of ships destined for recovery and listed in Annex V as hazardous waste are also banned if destined to countries to which the OECD decision does not apply
- Exports of ships destined for recovery in countries to which the OECD decision applies is only allowed if destined for environmentally sound management
- All exports of ships destined for recovery is subject to control requirements.

However, these rules can easily be evaded, partly because the waste definition to some extend, is based on subjective criteria and partly due to the interlinkages with the Law of the Sea - in particular the special status of the high seas.

That being said, there has in recent years been a number of cases where shipments of ships destined for recycling outside the EU have been rejected on the basis of the EU Waste Shipment Regulation, as indicated above and a further described in Chapter 3.

2.2.3 The London Convention and its 1996 Protocol

The 1972 London Dumping Convention prohibits the dumping of certain wastes at sea and requires either a general or specific permit to be obtained

[16] In July 2003 the European Commission presented its proposal to amend the Waste Shipment Regulation COM/2003/0319 final - COD 2003/0107 following the amendment to the OECD Decision in 2001. The current shipment procedures and control regimes will largely remain the same.

from the authorities of the loading state, or where this state is not Party to the Convention, from the flag state for all other waste.

The dumping of waste and other matters listed in Annex 1 of the Convention is prohibited e.g. crude oil and fuel oil. Where these are only contained as trace matters in other wastes they will not be subject to the prohibition concerning Annex 1 matters, but instead a permit must be obtained depending on the nature of the waste in which they are contained. As regards vessels, an absolute prohibition on dumping does therefore not exist, but the scope for permission is limited. The Specific Guidelines for Assessment of Vessels, which is intended for use by the national authorities when assessing whether a dumping permit should be issued, require the ship to be cleaned and dangerous matters to be removed prior to dumping.

The 1972 London Convention is amended by a 1996 protocol, which is yet to enter into force. This Protocol will strengthen the prohibition on dumping, but as regards vessels, the above mentioned guidelines will remain in force.

2.2.4 The recent IMO, ILO and BC guidelines for ship recycling - in brief

A set of interrelated guidelines for ship recycling have recently been developed in the context of the IMO, the Basel Convention and the ILO respectively.

The IMO Guidelines deal with the requirements before the ship enters the recycling facility (preparation for recycling). The Guidelines were adopted by IMO at the 23rd assembly in December 2003.

The Basel Convention Guidelines deal with the requirements regarding dismantling of ships at the recycling facilities in the destination state and, to a certain extend, requirements prior to shipping in the dispatch state. The Guidelines were adopted in December 2002 at the Sixth Meeting of the Conference of the Parties to the Basel Convention (COP 6).

The ILO Guidelines deal with the safety and occupational health aspects throughout the entire process. The guidelines were endorsed at the tripartite meeting in October 2003. The Guidelines were adopted by the General Body at its recent meeting in March 2004.

In addition a preliminary Industry Code of Practice on Ship Recycling has been prepared in the context of the International Chamber of Shipping by its Industry Working Party on Ship Recycling, IWPSR. Furthermore, a number of ship recycling state has developed, or is currently developing, guidelines for ship scrapping.

The different guidelines are described in more detail in Chapter 7. The focus is on the content of the guidelines, in particular which part of the recycling process covered by the respective guidelines and how these interrelate.

2.3 International initiatives and trends

The international community has in recent years increasingly been addressing environmental, health and safety problems related to ship breaking. Some of the recent and planned initiatives are summarised below.

2.3.1 Towards inter-agency cooperation

Following the adoption of the Basel Convention Guidelines on ship dismantling, COP 6 (December 2002) requested the secretariat of the Basel Convention (SBC) to explore the possibility of developing an inter-agency technical assistance project on ship scrapping together with the IMO and ILO, and to consider the establishment of a joint working group with the IMO and ILO as a means of achieving a common understanding of the problem and the character of the required solutions.

The 49th Session of the Marine Environment Protection Committee (MEPC) (July 2003) of the IMO supported these proposals and requested the secretariat of the IMO to liaise with the ILO and SBC in order to prepare the following for consideration by the 51st Session of the MEPC (April 2004):

- A draft project objective for the inter-agency technical assistance project
- A draft terms of reference for the joint working group.

In order to advance inter-agency cooperation, the secretariats of the IMO, ILO and SBC met in Geneva at the ILO from 13 to 14 January 2004, to explore the establishment of a joint working group. The three secretariats agreed that a Joint ILO-IMO-Basel Convention Working Group (Joint WG) should act as a forum for consultation, coordination and cooperation in relation to the work programme and activities of the ILO, IMO and the Conference of Parties to the Basel Convention with regard to issues related to ship scrapping. The Joint WG would take a coordinated approach to ship scrapping with the aim of avoiding duplication and overlap with respect to the mandates of the respective organizations.

A set of draft Terms of Reference were endorsed by the relevant bodies of the ILO[17], IMO[18] and Basel Convention[19].

The first meeting of the Joint ILO-IMO-Basel Convention Working Group will be held before the end of 2004.

With respect to technical assistance, regional or national workshops and seminars on ship scrapping, it is foreseen that these will be organized jointly, or individually by the ILO, IMO and SBC. These workshops/seminars should aim at raising awareness on the safety, health and environmental issues associated with ship scrapping and provide guidance on the implementation of the provi-

[17] For the ILO, the Committee on Sectoral and Technical Meetings and Related Issues at its 289th Session on 8 - 12 March 2004.

[18] For the IMO MEPC 51st Session in April 2004.

[19] The draft ToR was also considered by the third Session of the Open-ended Working Group (April 2004) and will be forwarded for COP 7 in October 2004 for adoption.

sions of each organization's respective guidelines. It has been agreed that any organization organizing a workshop or seminar would invite the other two organizations to participate.

It has been acknowledged that, for some developing countries, the implementation of the relevant guidelines on ship scrapping would necessitate massive investments, in e.g. adequate waste reception facilities at the recycling yards, environmentally sound waste management systems and appropriate infrastructure to ensure decent working conditions.

For this reason, one of the issues likely to be considered is the possibility to develop a global programme with a strategy for resource mobilization (e.g. World Bank, Asian Development Bank, the Global Environment Facility, UNDP, bilateral donors), in which the three organizations would participate.

With regard to specific technical cooperation projects, at present, the only ship-scrapping technical cooperation project is an ILO project on Safe and Environment-friendly Ship Recycling in Bangladesh. However, all three agencies have proposals to develop further activities.

2.3.2 The ongoing work to clarify the application of the Basel Convention with regard to ships - a status

A number of legal aspects of the full and partial dismantling of ships is currently being addressed by the Basel Convention. These include:

- The more specific criteria to be used for determining when a ship becomes waste
- Application of the notification procedures under the Basel Convention
- Application of the duty to re-import under the Basel Convention to ships that have become waste for control under the Basel Convention and that are subject to transboundary movements
- The role of states, e.g. which states should assume the obligations under the Basel Convention with respect to ships that have become waste
- Application of the Basel Convention annexes.

A report indicating possible solutions is to be presented to the forthcoming meeting of the Conference of the Parties in October 2004.

3 Ship scrapping cases

3.1 Examples of the Basel Convention and the EC Waste Shipment Regulation being applied to end-of-life ships

In recent years been a number of cases have arisen where the Basel Convention and/or the EC Waste Shipment Regulation have been applied to end-of-life vessels and ships for scrapping. Although these regulation already applies to the scrapping issue, the cases show that it has been very difficult to prove a ship owner's intent to dispose. In other cases, vessels are abandoned in harbours leaving the responsibility to the port if the owner cannot be identified.

There are several court rulings on specific ships considered as hazardous waste and others, on old ships in general, to be considered as (potentially) hazardous waste. In some cases, ships have been detained in European ports as they were believed to be on their way for scrap in a non-OECD country. In other cases, countries, where the ship was supposed to be scrapped, have denied the ship entry to their territory on the suspicion or knowledge of it containing hazardous materials.

Examples of recent case law:

- Bangladeshi Supreme Court rule of 19th April 2003 that the Bangladesh government should ensure that the import of ships for scrapping purposes is regulated in line with the requirement of the Basel Convention, 1989.

- Indian Supreme Court order of 14th October 2003 on Hazardous Waste Management Rules, which directs that the state pollution control board should ensure that the ship should be properly decontaminated by the ship owner before breaking. The same order also reiterates the ban on import of 29 items including waste asbestos following the Government of India ban on import of asbestos waste in 1998.

- A ruling by the Turkish Supreme Court on the import of vessels for scrap has been reported. A recent letter of 14th November 2003 from the Ministry of Environment and Forest to the Basel Convention Secretariat points specifically to import of ships for scrapping containing hazardous waste as illegal.

Table 3.1 contains a list of the identified cases of ships having been detained in European ports or denied entry to (primarily non-OECD) countries for scrapping on the basis of the Basel Convention or the EC Waste Shipment Regulation. Some of the cases are described in more detail in the following paragraphs.

To this may be added a number of cases where ships have been abandoned in a harbour and are detained for lack of port fee, to poor un-seaworthy technical condition etc., but where hazardous waste may be an issue if such a ship is sold for scrap. Examples of cases of abandonment of such ships can for instance be found on the official homepage of the Paris Memorandum of Understanding on Port State Control, www.parismou.org.

Table 3.1 Ships being considered hazardous waste (Besieux, 2004)

Ship	Case	Date
MV Forthbank	Detained in the Port of Antwerp, Belgium	Dec. 1999
Sandrien	Detained in the Port of Amsterdam, The Netherlands	Aug. 2000 -
Olwen	Denied entry to Turkey	Feb./March 2001
Olna	Denied entry to Turkey	Feb./March 2001
Otapan	Detained in the Port of Amsterdam, The Netherlands	July 2001 -
Sea Beirut	Denied entry to Turkey	May 2002
Silver Ray	Detained in the Port of Antwerp, Belgium	Feb. 2003 -
Novocherkassk	Denied entry to Turkey	July 2003
Hesberus	Denied entry to Alang Beach, India	Oct. 2003
Clemenceau	Denied entry to Turkey and Greece	Nov. 2003
Genova Bridge	Denied entry to Alang Beach, India	Nov. 2003

3.1.1 Case descriptions

Detainment of MV Forthbank in the harbour of Antwerp

In 1999, the 26-year old UK owned bulk carrier MV Forthbank was arrested in the harbour of Antwerp, Belgium. The ship was believed to be on its way for scrapping at the Alang Beach in India.

The ship arrived in Antwerp on December 20th 1999. The Belgian authorities represented by the Belgian Flemish Waste Department, OVAM (Basel Focal Point in Belgium) and the police carried out an investigation on board MV Forthbank and requested a written clarification from the owner of the ship, on his intentions with the ship.

The Belgian Authorities received a written response from the owner on December 20th 1999. The authorities considered the answer unclear and OVAM booked a charge at the Antwerp prosecutor who arrested the vessel on the base of that charge (penal arrest). The charge from OVAM and the arrest of the prosecutor were based on article 26 of the Council Regulation (EEC) No 259/93 of February 1st 1993 on the supervision and control of shipments of waste within, into and out of the European Community.

Following the arrest of MV Forthbank, OVAM asked the owner of the ship for a written confirmation, by means of a contract or agreement, that the ship would return to a European harbour after calling of its final port of Madagascar as stated in the ship's contract. On the 21st December 1999, a declaration from the insurance company of the MV Forthbank was delivered to the prosecutor. On the basis of this declaration the prosecutor lifted the penal arrest of the ship.

Following this, OVAM sent a letter to the owner of MV Forthbank and the prosecutor with a warning that legal action could be taken if the ship went to India or any other non-OECD-country following its departure from Antwerp, as the last harbour of an OECD-country, for demolition. MV Forthbank left the Antwerp harbour.

MV Forthbank was scrapped in 2002 at Chittagong, Bangladesh.

Detainment of Sandrien in the Port of Amsterdam
The Sandrien is a chemical tanker of 8,380 LDT built in 1974. The ship was owned by an Italian shipping company when it arrived in Amsterdam in August 2000. Shortly after its arrival in Amsterdam harbour the ship was detained by the port authorities due to its technical state. Inspections showed it had serious corrosion problems (Greenpeace, 2004).

The ship inspectors decided that the vessel was only allowed to leave Amsterdam after undergoing fundamental repairs. The inspectors further informed the environmental inspectors on the suspicion that the ship contained hazardous materials and could be bound for scrapping.

In February 2001, the Dutch Environmental Inspectorate arrested the Sandrien as the ship contained hazardous materials, for instance asbestos and heavy metals, and there was a contract on scrapping the ship in Asia. Such export to Asia would violate the European Waste Shipment Regulation.

After several court procedures the Council of State in the Netherlands in June 2002 ruled that an end-of-life vessel not properly cleaned of hazardous materials should be classified as hazardous waste. This was the first legal recognition that a ship containing asbestos must be treated as hazardous waste. During the process, the Italian owner sold the ship to a Mauritian company.

Sandrien still lies in the Amsterdam harbour. An inventory of hazardous materials onboard the ship has recently been completed and the owner has been asked to come up with a dismantling plan within April 2004. Negotiations with interested parties are ongoing for pre-cleaning/recycling the ship in Europe (Luttikhuizen, 2004).

Detainment of Silver Ray in the Port of Antwerp

Silver Ray is a ro-ro (roll-on/roll-off) ship built in 1978. The ship was owned by a Greek shipping company when it in May 2002 arrived in the Belgian harbour of Antwerp, where it should load some older cars destined for the African market. During its stay in Antwerp, the ship caught fire and was declared "construction total loss".

In October 2002 it was proved that the ship contained asbestos resulting in the Belgian Minister of Environment stating that the ship had to be considered as hazardous waste as long as it contained hazardous materials including its cargo of fire damaged cars.

The Greek owner sold the ship to a Panamese owner who renamed the ship Naxos 1. The new owner started repairing the ship and decontaminating the cargo, but refused to decontaminate the ship itself (Greenpeace, 2004).

The Belgian Minister of Environment then went to court and in February 2003 the Belgian court decided that the Silver Ray (Naxos 1) was hazardous waste according to the Basel Regime Protocol.

The Silver Ray still lies in the Antwerp harbour. A plan for decontamination of the ship has been drawn up and negotiations on the actual decontamination are ongoing (Besieux, 2004).

Denial of entry of the Sea-Beirut to Aliaga, Turkey

Sea Beirut is a smaller ro-ro ship of some 4,200 DWT built in 1975. The ship sailed under Liberian flag when its engine broke down off Dunkirk, France. The ship was towed to the port of Dunkirk where it was abandoned by its owners through a formal letter of abandonment to the Dunkirk port authorities (Greenpeace, 2004).

The Dunkirk port authorities auctioned the ship to the German company MSK. A tugboat towed the Sea Beirut out of the Dunkirk harbour on April 2002. The cargo manifest stated that the destination was a ship breaking company in Aliaga, Turkey (Greenpeace, 2004).

When the Sea Beirut came close to the coast of Aliaga, Greenpeace activists entered the ship believing to have evidence that the ship contained asbestos. To rectify this, the Turkish Minister of Environment took samples from the ship. Asbestos were shown in the samples. On the basis of the Turkish law, the minister refused to accept the ship entering Turkey. The ship should instead return to the country of origin. Turkey thus became the first ship breaking country to refuse an end-of-life vessel on grounds of the Basel Convention.

On July 7th 2002, the Turkish Ministry of Foreign Affairs officially notified France through the French Embassy in Turkey about the send-back decision of the Turkish Ministry of Environment. France replied that it did not accept responsibility of the ship (Greenpeace, 2004).

The Turkish ship breaking company asked the court to suspend the ministerial send-back decision. In October 2002, the Local Administrative court in Izmir, Turkey rejected the appeal of the ship breaker. The company then appealed to the Turkish Regional Administrative court. On November 2002, the head of the Turkish Regional Administrative court rejected the ship breaking company's appeal and added that the ship should be returned to France within 30 days.

France refused to take the ship back as they argued that the ship was the responsibility of Liberia as the ship's flag country, or Belgium, as the country where the ship carried out its final commercial operation (Frontline World, 2004).

On 16th February 2004, a Turkish court decided that the Sea Beirut must return to France (Neetc, 2004).

Denial of entry of the Genova Bridge at Alang, India

Genova Bridge is a ro-ro ship of 17,665 DWT built in 1980. The ship was operated by an English ship-owner when it, in November 2003, arrived at Alang, India to be scrapped (Greenpeace, 2004).

Following an appeal by Greenpeace, Indian authorities made inspections to determine any contents of hazardous materials onboard the ship. During these inspections asbestos were found onboard the ship.

The Gujarat Pollution Control Board directed the Gujarat Maritime Board to remove this asbestos and other possible hazardous materials onboard the ship. The asbestos were to be stored in a landfill in the hinterlands of Gujarat (Greenpeace, 2004).

Greenpeace argues that this decision is not in accordance with the Indian Supreme Court's rules on waste management which they find clearly states that the State Pollution Control Board should ensure that the ship owner decontaminates the ship before scrapping.

Denial of entry of the Clemenceau to Turkey and Greece

Clemenceau is a French aircraft carrier built in 1957. The vessel was laid-off in 1997 and has since been in Toulon, France. In September/October 2003, the vessel was sold to a Spanish scrapping yard for scrapping in Bilbao.

The vessel was towed from the port of Toulon on October 13th 2003. Shortly after its departure from Toulon, it was found on its way to Turkey. The French Government cancelled the contract with the Spanish firm and awarded it to the second low bidder (Shiprecycling, 2004).

The vessel was towed to Sicily to wait for a decision on its final destiny. An attempt was made to send the vessel to Greece for asbestos removal before sending it to Asia for scrapping. However, both Turkey and Greece refused entry of the vessel to their waters on the grounds that it contains hazardous substances like asbestos (Greenpeace, 2004).

In December 2003, it was decided to tow the vessel back to Toulon, France for asbestos removal. After this Clemenceau will be sailed to India for scrapping (Greenpeace, 2004).

4 The economics of the ship scrapping industry

4.1 Introduction

This section provides an overview of the driving mechanisms of the ship scrapping industry. The overview is focused on the economics of the ship scrapping industry and aims at describing the interaction with the other shipping markets and providing insight into the forces that determine when and where ships are scrapped. Key drivers behind the ship owners' supply of vessels for scrap and the ship scrapping yards' demand for the same are addressed separately first. Finally, the dynamics and equilibrium of supply and demand are discussed.

The information in this section serves as a reference for the analysis of the historical developments in the ship scrapping industry and the projections of the future volumes of ship scrapping under different scenarios.

4.2 The business cycle of the shipping market

Business cycles occur in most industries. Also in shipping, the business cycle is an integrated part of the business. The business cycles play a crucial role in fostering an efficient working industry by forcing the weakest and most poorly managed companies out of business during the downturns, leaving only the most efficient companies in business.

Basically the shipping industry consists of four markets:

- The *newbuilding market* trades new vessels
- The *freight market* trades sea transport services
- The *sale and purchase market* trades second-hand vessels
- The *demolition market* trades old and obsolete vessels.

The dynamics of the business cycles in shipping is a very complex matter, as a wide range of factors influence the fluctuations and because the four markets are closely interconnected. The shipping market in general is operating under business cycles with up and downswings with a cyclical behaviour. By managing risk and return on market investments, the business cycles play a central role in balancing the economics of the entire shipping industry.

The demand and supply in each market are, as mentioned, closely interconnected. If, for example, only few new ships are built and the demand for sea transport services increases (for example due to an upswing in the global economy) the price for sea transport services will increase. This will affect both the second-hand market and the demolition market. The price for second-hand ships will increase reflecting the higher earning potential and fewer ships will be sold for scrapping, also affecting the price in the demolition market. This will lead to an increased activity in the newbuilding market and, eventually, to a downward pressure on the price for sea transport services due to the increased supply of sea transport service.

The demolition market plays an important role as a buffer balancing demand and supply in the freight market. During a recession, the global demand for sea transport services stagnates or declines, which creates an overcapacity in the freight market leading to increased scrapping, thereby balancing out demand and supply. During an upturn in the business cycle the reverse occurs, as described above.

Predicting the development in the four shipping markets or in the business cycle is essentially what shipping is all about. However, predicting the cycles are very complex as many factors influence the four markets and thus the business cycles. Historical evidence shows that the cycles are not regular.

4.3 Supply of vessels for scrapping

The main cash inflow for ship owners is freight revenue. However, the ship owners also receive positive cash inflow from the demolition market when selling ships for demolition[20].

If the ship owner's decision on when to scrap a given vessel is not subject to any constraints, the ship owner simply evaluates the expected future earning potential and the expected cost of keeping the vessel in operation against the price obtainable when the vessel is sold for scrap.

When the revenue from selling the vessel for scrap outweighs the difference between the future earning potential and running cost, the ship owner will find it optimal to sell for scrap.

Given that the earning potential declines and the cost of keeping the vessel in operation increases as the vessel ages, the price a ship owner requires for selling the vessel for scrap declines, the older the vessel is. An important factor in

[20] This has been the case historically, but as we will argue later the value of a vessel for decommissioning could be zero or even negative. The implications of this are discussed later.

this consideration is the cost of taking the ship through the regular surveys[21] - surveys which widens in scope when the vessel ages. Considerable expenses are often necessitated by the fifth special survey at a vessel age of 25. Accordingly, freight rates have to be strong to justify the additional investments following the fifth special survey, if the ship owner shall not decide to sell for scrap.

Regulatory requirements can naturally interfere with this. If, for example, the ship owner's decision is subject to age limitations, the ship owner can be forced to supply the vessels to the ship scrapping yards earlier than he would otherwise find optimal.

Ignoring the cost of transporting the vessels to the ship scrapping yard (and possible regulation or company policies), the ship owner is presumably indifferent about *where* to scrap. The ship owner will simply choose to scrap the ship at the ship breaking yard offering the highest price.

The decisions of the individual ship owners are aggregated to give the total demolition supply at any given price. The aggregation provides the *demolition supply curve*, which basically answers the question: "How many vessels will (other things being equal) be sold for scrap given the price offered to the ship owners?"

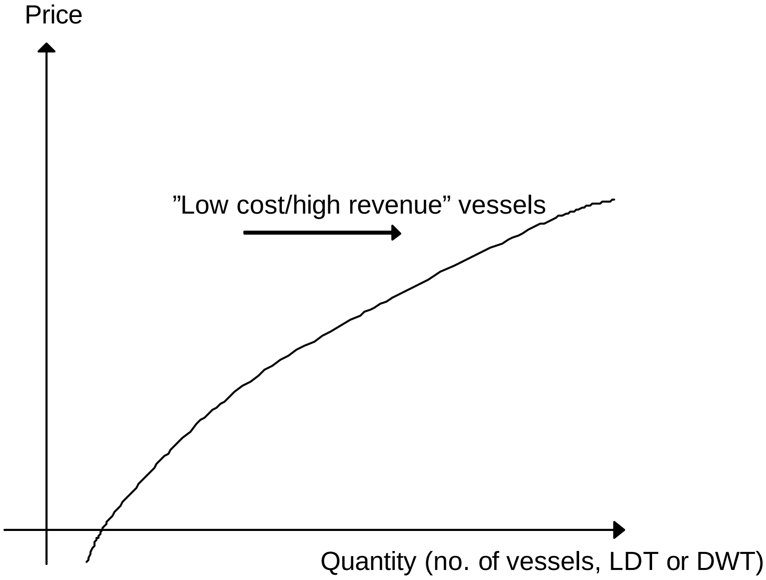


Figure 4.1 Demolition supply curve

[21] Merchant ship must undergo periodic surveys while in service to verify their acceptability for classification. Classification is generally necessary to obtain insurance. The classification procedures are, in general terms, agreed by IACS. All defects must be remedied before a certificate of seaworthiness is issued.

Figure 4.1 illustrates the point. As the price increases the incentive for the ship owners to sell their vessels for scrap increases, i.e. ship owners with better maintained and younger ships (low cost/high revenue) will choose to sell their vessels for scrap as the price offered by the ship scrappers increases.

It is important to emphasize that the curve shown in the figure above is only illustrative, i.e. the shape of the curve is not necessarily representative for the demolition market. The shape of the curve will be discussed later, when the importance of the key drivers is analysed.

The "position" of the supply curve is not static. Rather, it is dynamic and changes when the fundamentals or the key drivers of the shipping market change.

Five key factors for the "position" of the supply curve can be identified.

- *The future earning potential:* If the general market conditions in the freight markets improve, the supply curve shift upwards, as high earnings encourage the ship owners to keep trading. Accordingly, ship owners require a higher price to sell a vessel to the ship scrappers when the freight markets are strong (and vice versa for a decline in the future earning potential).

- *The cost of keeping the ship in operation (incl. cost of special survey):* If the cost of keeping the ships in operation increases (for example due to higher bunker/fuel cost, higher cost of survey etc.), the supply curve shifts downwards, as ship owners would then require a lower price to sell a vessel to the ship scrappers (and vice versa for declining cost of keeping the vessels in operation).

- *Age profile of existing fleet:* The supply curve shifts downwards the larger the share of old vessels is. The reason is that the earning potential declines and running cost increases the older the vessel is. Accordingly, ship owners will, on average, require a lower price to sell to the ship scrappers if the share of old vessels is high (and vice versa for a smaller share of old vessels).

- *The size of the current fleet:* Keeping other things equal, the constant increase in the world-fleet leads to an increased supply of vessels for the demolition market.

- *Regulation:* Regulatory issues, like phase out regulation, port state controls, statutory surveys, vetting systems etc., affect the demolition supply curve. These are factors that did not exist in the past, but are gaining importance at the moment for the key decision: whether to invest in the maintenance and follow operation or to sell the vessel for scrap. Accordingly, one key consideration is that increased maritime safety will likely lead, as a side effect, to increased scrapping activity.

As argued later, the scrap price is, under normal circumstances, of relatively little importance for the ship owners' decision on when to sell for scrap, i.e. the supply curve is almost vertical. The most important drivers are the developments in the freight rates and the cost of keeping the vessels in operation.

In Chapter 5, the importance of the above mentioned factors is analysed on the basis of the historical developments in the ship breaking industry.

4.4 Demand of vessels for scrapping

The decision of a (potential) ship scrapper to enter the market by buying a vessel for scrap is heavily influenced by the possibilities of selling the steel and other reusable items from the ship and the ship scrappers cost structure. At a given price of a vessel for decommissioning, it will be optimal for the ship scrapper to enter the market buying a vessel for scrap.

If for some reason revenue declines (if for example the price of steel or other reusable items declines) and/or the running cost of the ship scrapper increases, the ship scrapper will require getting the vessel for scrap at a lower price. Otherwise the ship scrapper will step out of the market.

Running costs, i.e. labour costs, taxes, capital costs, infrastructure, environmental requirements etc., are heavily influenced, and thus determined, by local conditions. The same goes for the revenue side. In some countries, the demand for steel and other reusable items is high, i.e. revenue possibilities better. Accordingly, ship scrappers in some countries/regions will be able to offer a higher price for a given vessel, if their costs are lower and/or revenue possibilities are better.

As the ship owners are assumed to be indifferent to where to scrap, the above mentioned factors influencing the demand side, determines this.

The activities of the individual ship scrappers are aggregated to give the total demand at any given price. The aggregation provides the *demolition demand curve*, which basically answers the question: "How many vessels will be demanded for demolition given the price of a vessel for decommissioning?"

The figure below illustrates this. As the price of a vessel for decommissioning increases, the incentive for entering the market weakens and only the ship scrapping yards with the most profitable market opportunities and/or lowest running costs are willing to pay - so demand shrinks (an vice versa for a decline in the price of a vessel for decommissioning).

In some countries, the high level of costs implies that the ship (scrapping) yards will only enter the ship scrapping market if the price of the vessels for decommissioning is negative[22] (as indicated in Figure 4.2).

[22] See for example EU (2000)

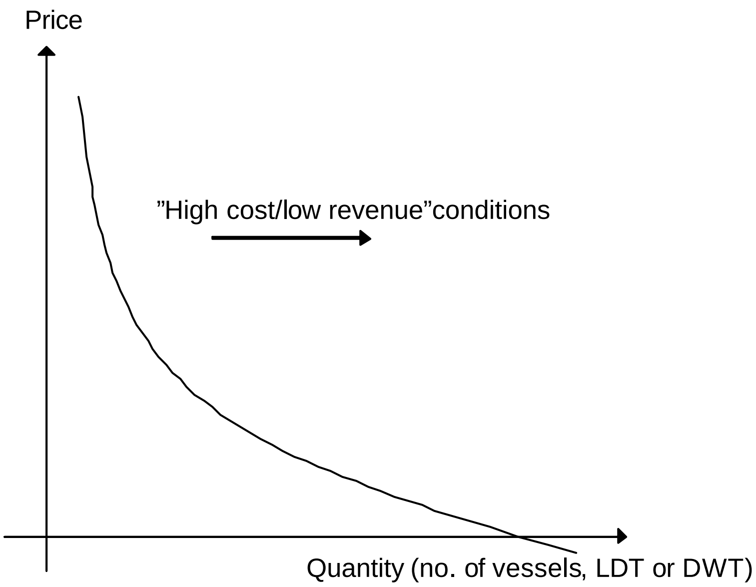


Figure 4.2 Demolition demand curve

It is important to note that the figure above is only illustrative, i.e. the shape of the curve is not necessarily representative for the demolition market.

The "position" of the *demolition demand curve* is, like for the supply curve, dynamic. The "position" changes when market conditions change. The following key factors for the "position" of the demand curve can be identified.

- *Demand for steel and other reusable items:* When the demand for steel and other reusable items increases, the ship scrappers' earning potential increases. Hence, the ship scrappers willingness to pay for a vessel for decommissioning increases (and vice versa for a weakening in the demand for steel and other reusable items).

- *Running costs* which to a large extent is determined by local conditions play a crucial role for the demand of vessels for decommissioning. An increase in either of the cost items listed below will shift the demand curve downwards, i.e. lower the ship scrappers willingness to pay:

  - *Labour costs* play, and have played a crucial role for the ship breaking industry. Given the current practice used, ship breaking is a very labour-intensive industry.

  - *Waste disposal costs:* Decommissioning involves large waste quantities for disposal.

  - Costs implied by *regulation (health, safety & environment):* Regulation also influences demand as higher requirements regarding health, safety and environmental issues increase the costs of ship scrapping.

- *Import duties, levies and taxes:* Ship scrappers which are subject to high duties, levies and taxes are less competitive compared to countries with no or low taxes.

- *Capital costs* play an insignificant role in present markets due to the basic nature of the industry. There is a potential of increasing productivity by using better technologies in the industry, but this will require large investments, which do not seem to be competitive to the current practice used. Capital costs may, however, play a crucial role when evaluating the potential for ship scrapping in industrialised countries, as economic feasibility of ship scrapping in "high cost" areas depends on efficient non-labour intensive techniques[23].

- *Infrastructure:* The better the infrastructure (roads, distance to takers of steel, access for the labour force etc.), the lower the running costs.

• *Exchange rates:* Exchange rates naturally affect the competitiveness of the ship scrapping yards, as the costs of the ship scrapping yard are paid in local currency (except from the vessels for decommissioning).

The above factors influencing the demand of ships for decommissioning are the key to understanding the pattern of decommissioning world-wide today and in the past. With no restriction of ship owner's decision on where to scrap, this is determined by which ship scrapper offers the best price. Ship scrappers with "high costs" due to, for example, high costs of labour and/or high disposal costs, have no chance of being in the market as long as ship scrappers with "low costs" have the capacity of processing the ships supplied to the industry.

Looking at the demand curve (Figure 4.2), the ship scrappers with the highest costs are located to the right of the demand curve. This part of the demand curve will possibly never be displayed in practice since the ship breakers are not able to attract ships for demolition. This explains why European ship recyclers are mostly absent from the market today. High running costs due to labour costs and costs associated with compliance of existing health, safety and environmental regulation imply that European ship recyclers are not competitive in an unregulated world market.

4.5 Supply and demand

Below, considerations from the previous sections are compiled into a general supply and demand setup. The dynamics of demand and supply are discussed in relation to changes in some of the key drivers (freight rates, phase out schemes, fluctuations in steel prices and regulation on health, safety and environmental issues in the ship scrapping industry).

[23] EU (2000)

4.5.1 Equilibrium

The figure below shows the aggregated supply and demand curves in the same setup, illustrating the relationship between price and quantity - the quantity demanded or supplied at various prices.

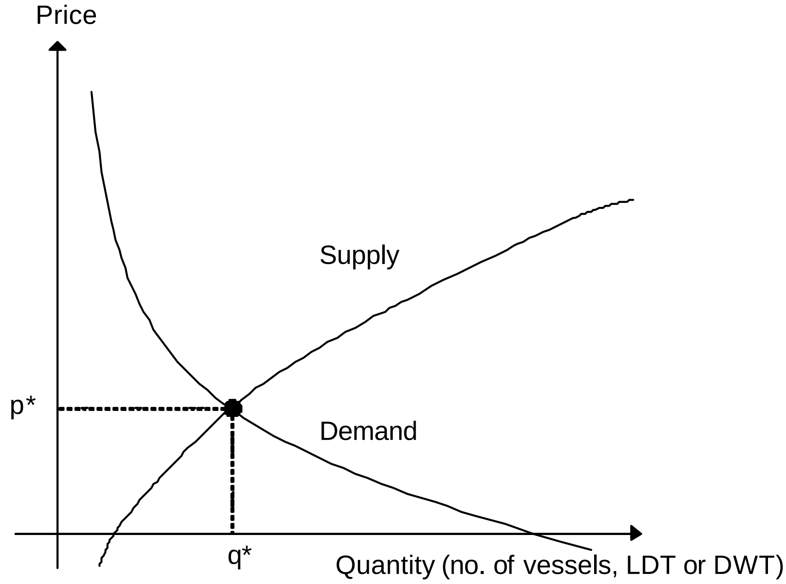


Figure 4.3 Supply and demand of ships for demolition

The interaction of the supply and demand curves determines the market price and quantity scrapped. Thus, the equilibrium or balance in a competitive market is the point where the supply and demand curve crosses. This is the price (p*) and the quantity (q*) of vessels that will be sold for demolition.

As the price of ships for demolition decreases, ship scrappers will demand more vessels for demolition and vice versa. A change of price causes a move along the demand curve. The same goes for the supply side. As the prices of ships for demolition increases, ship owners will supply more vessels to the decommissioning market and vice versa. Eventually, demand and supply will be in balance.

Historically, the price of a vessel for decommissioning has been positive (as shown in Chapter 5), i.e. ship owners have received money when selling their vessels for decommissioning.

However, under certain circumstances it could be so that the ship owners will have to pay the ship scrapping yards to decommission their vessels. This will be the case, if the supply of vessels for some reason (for example due to phase out schemes) increases to a level, where high cost ship scrappers can enter the market. Technically, this will happen if the supply curve moves so far to the right that it crosses the demand curve to the right of the point where the demand curve crosses the horizontal axis.

This could eventually, if the ship owners are not willing to pay for having their vessels decommissioned, lead to semi-permanent anchoring (or a ghost fleet). If the high supply of vessels is only temporary, the supply curve will shift back to the left pushing the price above zero again[24]. In such case, it will again be profitable to take the vessels from the semi-permanent anchoring to the ship scrappers.

4.5.2 Market dynamics

The balance between supply and demand in the ship scrapping industry is ever changing. The effect of changes in the key drivers of the industry is described below (not the price, as this is endogenously determined by demand and supply). The description of changes in the key drivers primarily focuses on the consequences in the demolition market.

Freight rates
Freight rates heavily influence the price of ships for demolition. Peaks in the freight rates are transmitted to the demolition market with a small delay, reducing the supply of ships for demolition, as higher freight rates make it more attractive for the ship owners to keep their vessels in operation. Technically, higher freight rates will shift the supply curve upwards, eventually, leading to increased prices and fewer ships sold for demolition. The new equilibrium is found where the "new" supply curve intersects the demand curve.

Phase out schemes
Regulation that put certain restrictions on the use of ships will affect the market equilibrium. A regulation calling for phase out of ships before the ship owners would otherwise find it optimal to scrap will increase the supply of ships for demolition. Technically, this will shift the supply curve to the right, eventually, leading to lower prices and more ships sold for demolition.

A phase out scheme increases the volume of ships that are decommissioned, which means that more demand will be satisfied. Thus, more ship scrappers will be in the market, or more of the less efficient capacity of existing ship scrappers will be utilised. If it is assumed that "low cost" ship scrappers are not able to process more ships, demand from "high cost" ship scrappers (for example European shipyards) may be satisfied. As mentioned, this could imply that the equilibrium price declines below zero.

A phase out scheme might affect both the freight markets and the newbuilding market. When more ships are scrapped, the supply of sea transport services declines leading to increased freight rates, which will ultimately lead to increased demand for new vessels (and, eventually, a higher supply of sea transport services).

[24] If no ship owners are willing to pay for getting their vessels scrapped, no negative price levels will be observed in the market. The only indicator that the equilibrium price is negative will be the setting up of semi-permanent anchoring.

Fluctuations in steel prices
Prices of recycled steel influence the price that ship scrappers can pay for a ship for demolition. If prices of recycled steel increases, the ship scrappers will be willing to pay more for the vessels, increasing the demand for ships for demolition. Technically, this will shift the demand curve to the right, eventually, leading to higher prices and more ships sold for demolition.

A higher level of decommissioning will result in more recycled steel on the market, which could, eventually, affect the price of recycled steel. However, BIMCO (2002, page 12) concluded that: "*recycled steel from ships forms an insignificant share of total steel production, as well as of the global supply of recycled steel*". Hence, the price for steel can be considered as exogenous in this context, i.e. the steel price is not significantly affected by the developments in the ship demolition market.

Health, safety and environmental regulation
When new regulation regarding health, safety and environmental aspects is introduced in the ship scrapping sector, the demand curve is affected. General stricter regulation will increase the costs of scrapping a ship, reducing the demand of ships for demolition. Technically, this will shift the demand curve to the left, eventually, leading to lower prices and fewer ships sold for demolition.

Health, safety and environmental issues are often implemented locally, whereas the market for demolition of ships is global. Hence, it is likely that new regulations will only affect part of the ship scrappers that form the total demand curve.

Technically, a regulation that only affects some of the ship scrappers will simply lower these ship scrappers' willingness to pay. A new aggregated demand curve will be formed with a shape that has been pushed downwards compared to the starting point. The new equilibrium will have a lower price and fewer ships sold for demolition, if ship scrappers that were originally "above the equilibrium point" are affected by the regulation. Moreover, local regulation may push some of the ship scrappers out of the market, because they are no longer competitive, i.e. the price that they are willing/able to pay for a ship for decommissioning is lower than the equilibrium price.

Market interactions
It is fair to assume that ship owners will sell ships for demolition to the ship scrapper paying the highest price, as long as there are no specific reasons to act differently. Accordingly, without further market interactions, it will primarily be the "low cost" ship scrappers that are in the market.

However, regulation can be used as a means to provide a sufficient incentive for the ship owners to sell their ships to ship scrappers complying with specific safety, health and environmental criteria, such as the IMO, ILO and Basel Convention guidelines for ship scrapping. One way could be to simply subsidy "high cost" ship recyclers (for example European ship recyclers) so that they can offer prices for ships for decommissioning that are competitive to the prices offered by ship scrappers from "low cost" countries. Technically, a properly applied subsidy-scheme to European ship recyclers will increase the price that they are willing to pay for ships for decommissioning. A new aggregate demand curve will be formed where European ship recyclers will be in the market.

Another way would be to simply use "command and control" regulation forcing ship owners to scrap in certain countries/under certain conditions. However, without world wide support, command and control regulation will probably only have little effect.

4.6 Capacity

It is important to clarify a few points regarding supply and demand in relation to the term *capacity*.

Quantity is sometimes mistaken for *capacity*. However, the quantity observed in the market is merely the *volume* provided at that specific point in time to match supply. It says nothing about the *maximum quantity* or *capacity* that the ship scrapping yards can handle. In this report, the term *capacity* is used only in relation to discussions about constraints to the volume of ships the ship scrapping yards can process.

Regarding the capacity of decommissioning of ships, there is no evidence that there have been any *capacity constraints* in the industry historically which have seriously affected prices or volumes of scrap. If the current practice is used in the future, no capacity constraints can be foreseen, as decommissioning with the currently applied practice only requires a suitable beach, plenty of labour and a hinterland force requiring steel - all of which seems to be readily available in large quantities in some of the developing countries in Asia.

Rather than *capacity constraints*, it seems that the key drivers behind supply and demand for ships for decommissioning have determined the historical level of scrapping and the equilibrium price.

5 Historical developments in the ship scrapping industry

This section describes the recorded scrapping activity during the last 10 years. Estimates of historical scrapping volumes (number of vessels, DWT and LDT) are provided by geographical regions. Special attention is given to the historical scrapping of oil tankers.

Furthermore, average life time expectancy for all relevant types of vessels is presented. The findings are used in the assessment of the possible future developments in the ship scrapping industry (Chapter 6).

The influence and importance of the key drivers for the developments in the ship scrapping industry, identified in the previous section, with regard to scrapping volumes and prices are also analysed. This also serves as an input to the scenario analyses presented in Chapter 6.

5.1 Methodology for analysis of historical developments

The methodology applied for the analysis of the historical developments in the ship breaking industry is described below. This includes a description of data, segmentations, approximations and delimitations.

It should be emphasised that the analysis focuses on vessels of 2,000 DWT and above.

5.1.1 Data

The analysis of historical scrapping volumes is based on data from Clarkson Research. The data on historical scrapping is compiled from the Clarkson's fleet database (October 2003) and Clarkson's demolition database (2002). Together, these two databases cover a wide range of information on all merchant ships scrapped from 1994 to 2003 (January-September); including type of vessel, size of vessel, place of scrap, scrap price etc.

5.1.2 Segmentation

For analytical purposes, the fleet (both scrapped and current) has been split into eight *type segments*. The segmentation is based on a categorisation of the "sub types" used in Clarkson's databases. For each segment, relevant size ranges have been defined. The details of the segmentation are shown in appendix 1. For the analysis of the historical developments, no distinction is made between the hull types of oil tankers (as done for the projections). The tanker segment is simply split into *oil tankers* and *other tankers*.

The details of the geographical segmentation are also provided in appendix 1.

5.1.3 Approximations/Delimitations

Historical volumes of ship demolition are estimated by number of vessels, DWT and LDT. For some of the scrapped vessels, information is not available on LDT. For these vessels, LDT is estimated on the basis of a unit conversion factor based on the DWT of the ship. A unit conversion factor is estimated for each segment and size range. The details of this are presented in appendix 2.

Due to problems of exact segmentation and lack of data on some of the relevant parameters, all details are presented and the results of the analyses are benchmarked against existing studies when available.

5.2 Historical decommissioning volumes

Developments in the market for ship breaking during the last 10 years are presented in tables and figures below. The first section covers all types of vessels whereas the second section focuses on oil tankers.

5.2.1 All types of vessels

The historical scrapping volumes of all types of vessels (LDT, DWT and number of vessels) for the last decade are presented by region and year in the tables below. Table 5.1 shows the volumes by break up location and year, whereas Table 5.2 shows the total volumes scrapped during 1994-2003 by break up region.

The tables show that in the past 10 years decommissioning of ships have been heavily concentrated to countries in the Indian Sub Continent and Asia. Thus, ship breaking in India, Bangladesh, Pakistan, and China has accounted for more than 90% of the total volume of ships scrapped (LDT). Only a small amount of ship scrapping has been carried out in Western Europe and other OECD countries. Less than 2% of the ship scrapping seen from 1994-2003 has taken place in Europe of which Turkey alone accounts for more than 85%.

The reason for this is simply that the economics of ship scrapping are not in favour of EU countries. It is not only due to the higher labour costs and the cost of protecting human health and the environment, but also due to the fact that the demand for recycled steel and other reusable items from ships is lower in the EU compared to, for example, the Indian Sub Continent or China. The prices obtained in third world countries are consequently better on a per tonnes of steel basis (EU, 2000).

From 1994-2003, approximately 4,700 ships have been demolished world wide. There have been considerable variations in the level of activity over the years. The ship scrapping activity peaked in 1999 with 600 ships being scrapped representing approximately 6.4 million LDT and dipped in 1995 with ships representing only approximately 3.0 million LDT being scrapped. Broadly, the same pattern of historical demolitions is found in a wide range of sources (see for example (BIMCO, 2002) and (EU, 2000)).

Table 5.1 Total historical ship scrapping volumes (all types) by region and year (Million LDT, Million DWT and number of vessels)

Scrap location	Unit	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Un-known	Total
Bangla-desh	mLDT	0.5	0.6	0.9	0.7	1.1	1.2	0.8	1.7	1.4	0.7	0.0	9.6
	mDWT	3.1	3.9	4.6	3.2	5.8	7.2	4.2	9.5	8.7	4.1	0.0	54.2
	No.	25	31	61	63	66	65	61	123	69	39	0	603
India	mLDT	1.3	1.4	2.2	2.1	2.8	2.8	2.1	2.2	2.9	1.9	0.0	21.7
	mDWT	6.5	6.1	8.8	7.7	10.0	10.6	8.1	8.1	11.1	7.6	0.1	84.7
	No.	107	148	262	293	360	340	274	298	326	229	1	2,638
Pakistan	mLDT	0.6	0.5	0.3	0.2	0.6	0.7	0.2	0.6	0.3	0.2	0.0	4.0
	mDWT	3.7	3.1	2.0	0.9	3.4	4.3	1.2	3.7	1.7	1.0	0.0	24.9
	No.	19	20	16	14	40	34	16	26	13	14	1	213
Indian sub Continent	mLDT	0.1	0.1	0.1	0.3	0.3	0.1	0.1	0.1	0.0	0.0	0.0	1.2
	mDWT	0.9	0.4	0.6	1.4	1.1	0.8	0.6	0.5	0.1	0.2	0.0	6.6
	No.	6	2	9	18	24	9	7	5	1	2	0	83
China	mLDT	0.5	0.2	0.1	0.0	0.5	1.0	1.1	1.1	1.3	1.5	0.1	7.4
	mDWT	2.8	0.9	0.3	0.1	2.1	5.4	5.7	5.7	5.9	8.2	0.1	37.1
	No.	34	19	13	6	48	72	77	76	90	79	9	523
Vietnam	mLDT	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.4
	mDWT	0.3	0.4	0.2	0.5	0.4	0.3	0.1	0.0	0.0	0.0	0.0	2.3
	No.	3	2	6	3	5	5	4	1	1	0	0	30
Other Asia	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	mDWT	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.6
	No.	0	2	1	1	1	4	0	1	1	1	0	12
EU	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	mDWT	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.3
	No.	2	1	1	3	7	3	3	2	4	1	0	27
Turkey	mLDT	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.7
	mDWT	0.0	0.1	0.2	0.2	0.3	0.6	0.2	0.3	0.3	0.1	0.0	2.3
	No.	2	5	10	12	15	18	14	16	21	12	0	125
North America	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	mDWT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2
	No.	0	0	0	0	0	0	0	1	4	1	0	6
South America	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	mDWT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	No.	1	1	0	0	2	1	1	2	1	0	0	9
Mexico	mLDT	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
	mDWT	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.3
	No.	0	1	0	2	6	8	1	0	1	0	0	19
Other	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	mDWT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.	0	0	0	0	2	0	0	0	0	1	0	3
Unknown	mLDT	0.1	0.0	0.2	0.3	0.2	0.3	0.4	0.1	0.2	0.2	1.1	3.1
	mDWT	0.8	0.1	1.0	1.1	0.6	1.5	1.7	0.2	0.6	0.7	4.0	12.3
	No.	14	8	22	32	23	41	34	14	24	15	140	367
Total	mLDT	3.2	3.0	4.0	3.8	5.6	6.4	4.8	5.9	6.2	4.5	1.2	48.7
	mDWT	18.2	15.5	17.6	15.3	23.9	30.8	21.8	28.2	28.5	21.9	4.2	226.0
	No.	213	240	401	447	599	600	492	565	556	394	151	4,658

Note: "Indian Sub Cont" means that it can be in any of the three countries; India, Bangladesh or Pakistan.

Note: 2003 only includes January-September.

Note: Rounding will display digits <0.05 as 0.0

Table 5.2 Total ship scrapping volumes (all types) 1994-2003 by region (Million LDT, Million DWT and number of vessels)

Scrap location		LDT		DWT		Vessels	
		Sum	%	Sum	%	Number	%
Indian Sub Continent	Bangladesh	9.6	19.8%	54.2	24.0%	603	12.9%
	India	21.7	44.5%	84.7	37.5%	2638	56.6%
	Pakistan	4.0	8.3%	24.9	11.0%	213	4.6%
	Indian Sub Cont	1.2	2.6%	6.6	2.9%	83	1.8%
	Total	36.6	75.2%	170.5	75.4%	3537	75.9%
Asia	China	7.4	15.2%	37.1	16.4%	523	11.2%
	Vietnam	0.4	0.9%	2.3	1.0%	30	0.6%
	Other Asia	0.1	0.2%	0.6	0.2%	12	0.3%
	Total	8.0	16.3%	40.0	17.7%	565	12.1%
Europe	EU	0.1	0.2%	0.3	0.1%	27	0.6%
	Turkey	0.7	1.4%	2.3	1.0%	125	2.7%
	Total	0.8	1.7%	2.6	1.1%	152	3.3%
Americas	North America	0.0	0.1%	0.2	0.1%	6	0.1%
	South America	0.1	0.1%	0.2	0.1%	9	0.2%
	Mexico	0.1	0.2%	0.3	0.1%	19	0.4%
	Total	0.2	0.4%	0.6	0.3%	34	0.7%
Other/ Unknown	Other	0.0	0.0%	0.0	0.0%	3	0.1%
	Unknown	3.1	6.3%	12.3	5.4%	367	7.9%
	Total	3.1	6.4%	12.3	5.5%	370	7.9%
	Total	48.7	100%	226.0	100%	4,658	100%

Note: "Indian Sub Cont" means that it can be in any of the three countries; India, Bangladesh or Pakistan.
Note: 2003 only includes January-September.

The global volume of scrapping is related to the overall size of the world fleet. The constant increase over the years in the size of the world fleet has led to a general increase in the supply of ships to the ship scrapping industry, as illustrated in the figure below. The trend in volumes of ship scrapping has followed the increasing trend in the size of the fleet. However, it is also evident that there have been large variations over the years. These variations are determined by the developments in the key drivers of supply and demand.

It is important to bear in mind that the age profile of the world fleet plays a prominent role in this. For example, the large number of newbuildings delivered the last couple of years will not directly affect the level of scrap in the coming years, as these vessels are scrapped with a time lag of 20-30 years.

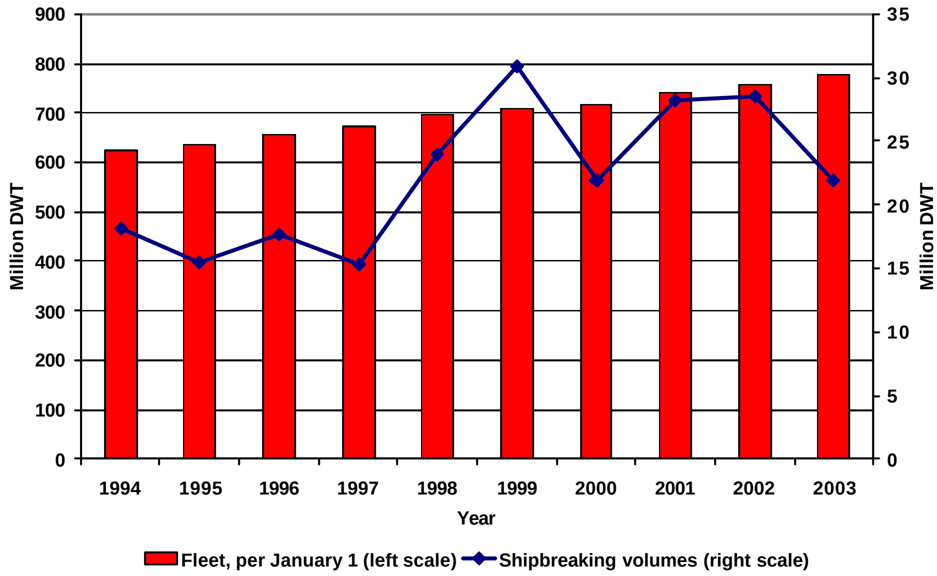


Figure 5.1 Ship breaking volumes and the size of the fleet

The tables and figure above only cover the developments of ship scrapping during the past 10 years. However, looking back even further the demolition of (European) vessels has moved from locally in the European region, notably Spain and Italy, and Japan during the 60's and 70's to Asian countries such as Taiwan and Korea in the 80's. In those days ship scrapping took place along piers in connection with ship building activities. During the 1980's the method of beaching became the most frequent method used for demolition since expensive infrastructures like piers, sufficient depth of the harbour, cranes etc. could be replaced by a mud flat, portable equipment and a huge labour force. As the economy grew in Korea and Taiwan, labour costs increased making ship scrapping less attractive in these countries. Consequently, they left the market and were replaced by new countries with lower labour costs (see also Section 5.5.3).

It would be interesting to analyse the nationality of the vessels scrapped. However, there is no clear way of identifying the nationality of the vessels scrapped. One possible, but troublesome, way is by using the flag state. The distribution of the scrapped vessels by flag state is presented in the figure below. As can be seen, 14% of the vessels scrapped were operating under EU flag at the time of scrap, whereas the new EU Member States, notably Cyprus and Malta, have accounted for 18%. EU member states are here defined as Member States per January 1 2004, New EU Member States as the 10 countries which entered May 2004, whereas EU accession countries include Bulgaria, Romania and Turkey.

It is clear that the share of vessels operating under EU flag is much higher than the share of vessels scrapped at European yards. While 14% of the vessels were operating under the flag of EU Member States at the time of scrap, EU only accounted for 0.1% of the decommissioning (see Table 5.2, by DWT).

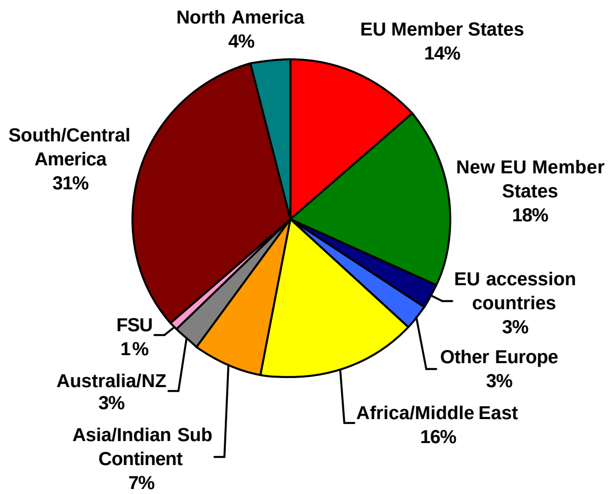


Figure 5.2 Total scrapped vessels by flag state (share of DWT)[25]

The scrap location for the vessels scrapped under the flag of EU Member States, new EU Member States and EU accession countries are shown in the table below. The far right column shows the comparable distribution for all the vessels scrapped during 1994-2003. As it can be seen, only 1.1% of the vessels operating under the flag of EU Member States at the time of scrap have been scrapped in Europe and the picture is broadly the same for the New EU Member States. Generally, there are no big differences between the scrapping pattern of vessels operating under EU-related flags at the time of scrap and the scrapping pattern for all vessels.

[25] Based on Clarkson fleet database (October 2003), covering 2001-2003.

Table 5.3 Scrap location by flag state region (share of DWT)[26]

Scrap location	Flag state region (EU-related)				All scrapped vessels (1994-2003)
	EU Member States	New EU Member States	EU accession countries	Total EU-related	
Indian Sub Continent	68.2%	79.1%	84.0%	75.1%	75.4%
Asia	28.9%	14.8%	4.7%	19.6%	17.7%
Europe	1.1%	1.4%	6.5%	1.7%	1.1%
Americas	0.0%	0.2%	0.0%	0.1%	0.3%
Other/unknown	1.8%	4.6%	4.9%	3.5%	5.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

5.2.2 Oil tankers

The tables below present the same information as above for oil tankers only, i.e. historical scrapping volumes (LDT, DWT and number of vessels) of oil tankers by scrap location, year of scrapping and the distribution of ship breaking activity by region for the last decade.

[26] Based on Clarkson fleet database (October 2003), covering 2001-2003 (except for the data in far right column "all scrapped vessels").

Table 5.4 Historical ship scrapping volumes of oil tankers by region and year (Million LDT, Million DWT and number of vessels)

Scrap location	Unit	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Un-known	Total 1994-2003
Bangla-desh	mLDT	0.4	0.5	0.3	0.2	0.6	1.0	0.5	1.1	1.2	0.6	0.0	6.4
	mDWT	2.5	3.4	1.6	1.3	3.8	6.6	3.1	7.1	8.1	3.8	0.0	41.2
	No.	15	21	9	7	20	45	30	56	47	28	0	278
India	mLDT	0.6	0.7	0.5	0.2	0.1	0.4	0.7	0.3	0.9	0.9	0.0	5.1
	mDWT	3.3	3.7	2.5	0.9	0.2	2.6	3.6	1.4	4.5	4.6	0.0	27.4
	No.	38	51	37	15	6	24	56	21	86	82	0	416
Pakistan	mLDT	0.5	0.4	0.2	0.1	0.2	0.5	0.2	0.5	0.2	0.1	0.0	2.9
	mDWT	3.3	2.8	1.2	0.3	1.6	3.7	1.0	3.4	1.6	0.9	0.0	19.8
	No.	14	13	6	3	9	24	9	15	7	11	0	111
Indian sub Continent	mLDT	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.6
	mDWT	0.9	0.4	0.3	0.6	0.1	0.3	0.5	0.4	0.0	0.2	0.0	3.7
	No.	5	2	3	5	2	3	4	3	0	2	0	29
China	mLDT	0.1	0.0	0.0	0.0	0.1	0.4	0.6	0.5	0.4	0.9	0.0	3.1
	mDWT	0.7	0.0	0.0	0.0	0.7	2.7	3.7	3.2	2.9	6.6	0.0	20.5
	No.	4	0	0	0	5	13	23	21	17	34	0	117
Vietnam	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	mDWT	0.2	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
	No.	1	1	0	1	0	0	0	0	0	0	0	3
Other Asia	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	mDWT	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	No.	0	1	0	0	0	0	0	0	1	0	0	2
EU	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	mDWT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.	1	0	0	0	0	0	0	0	2	0	0	3
Turkey	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	mDWT	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0	0.5
	No.	0	1	3	1	1	1	5	3	4	2	0	21
North America	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	mDWT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.	0	0	0	0	0	0	0	0	0	0	0	0
South America	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	mDWT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	No.	1	1	0	0	0	0	0	0	0	0	0	2
Mexico	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	mDWT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	No.	0	1	0	1	2	0	1	0	1	0	0	6
Other	mLDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	mDWT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	mLDT	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.3	0.9
	mDWT	0.6	0.0	0.3	0.2	0.1	0.7	1.2	0.1	0.0	0.3	1.9	5.4
	No.	3	3	2	5	1	8	13	5	2	4	27	73
Total	mLDT	1.8	1.8	1.0	0.6	1.0	2.5	2.2	2.5	2.9	2.7	0.3	19.3
	mDWT	11.5	10.8	6.0	3.6	6.5	16.6	13.3	15.7	17.2	16.4	1.9	119.4
	No.	82	95	60	38	46	118	141	124	167	163	27	1,061

Note: "Indian Sub Cont" means that it can be in any of the three countries; India, Bangladesh or Pakistan.

Note: 2003 only includes January-September.

Note: Data includes single hull, double bottom, double side and double hull tankers.

Note: Rounding will display digits <0.05 as 0.0

Table 5.5 Total ship scrapping volumes of oil tankers, 1994-2003 by region (Million LDT, Million DWT and Number of vessels)

Scrap location		LDT		DWT		Vessels	
		Sum	%	Sum	%	Number	%
Indian Sub Continent	Bangladesh	6.4	33.3%	41.2	34.5%	278	26.2%
	India	5.1	26.4%	27.4	23.0%	416	39.2%
	Pakistan	2.9	15.1%	19.8	16.5%	111	10.5%
	Indian Sub Cont	0.6	3.0%	3.7	3.1%	29	2.7%
	Total	15.0	77.8%	92.1	77.1%	834	78.6%
Asia	China	3.1	15.9%	20.5	17.1%	117	11.0%
	Vietnam	0.1	0.5%	0.6	0.5%	3	0.3%
	Other Asia	0.0	0.2%	0.2	0.2%	2	0.2%
	Total	3.2	16.6%	21.3	17.9%	122	11.5%
Europe	EU	0.0	0.0%	0.0	0.0%	3	0.3%
	Turkey	0.1	0.6%	0.5	0.4%	21	2.0%
	Total	0.1	0.7%	0.5	0.4%	24	2.3%
America	North America	0.0	0.0%	0.0	0.0%	0	0.0%
	South America	0.0	0.1%	0.1	0.1%	2	0.2%
	Mexico	0.0	0.1%	0.1	0.1%	6	0.6%
	Total	0.0	0.2%	0.1	0.1%	8	0.8%
Other/ Unknown	Other	0.0	0.0%	0.0	0.0%	0	0.0%
	Unknown	0.9	4.8%	5.4	4.5%	73	6.9%
	Total	0.9	4.8%	5.4	4.5%	73	6.9%
	Total	19.3	100%	119.4	100%	1,061	100%

Note: "Indian Sub Cont", not specified in the database. Can be in any of the three countries; India, Bangladesh or Pakistan.
Note: 2003 only includes January-September.

The tables above indicate that decommissioning of oil tankers more or less follows the same pattern as for all vessels. The vast majority of oil tankers have been scrapped in India, Bangladesh, Pakistan, and China. Only 3 oil tankers have been scrapped in EU during the last 10 years.

On an average basis, oil tankers have accounted for close to 40% of the volumes scraped during 1994-2003 (19.3 of 48.7 million LDT). However, as shown in the figure below, there has been large variation over the years. In 2003, demolition of oil tankers accounted for more than 60% of all demolitions, whereas in 1997 and 1998, the share was below 20%.

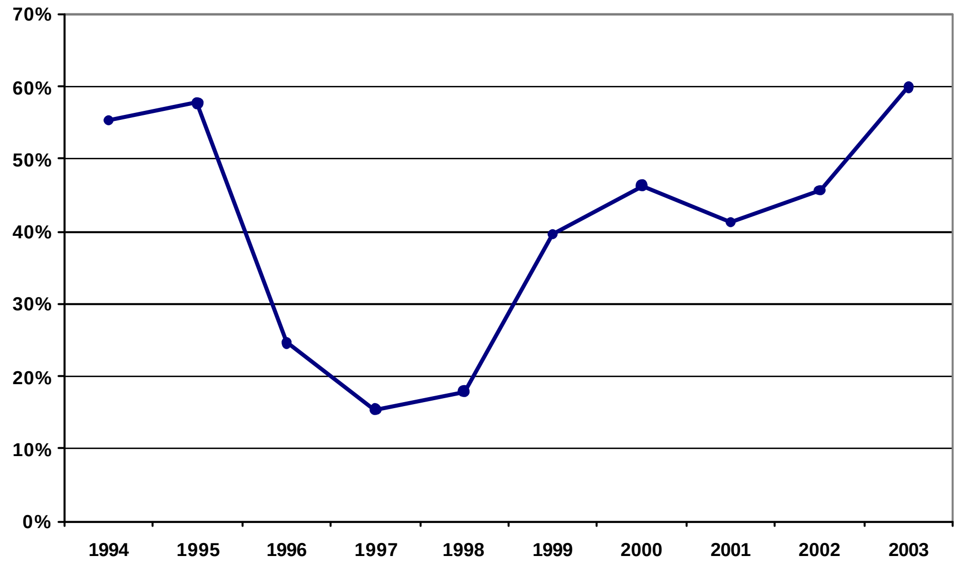


Figure 5.3 Oil tanker share of total global demolitions (share of LDT)

5.3 Average life time expectancy

The average historical lifetime for all segments and size ranges have been estimated on the basis of the vessels scrapped during 1994-2003. The estimated average lifetimes are used for projecting future volumes of scrap of all types of vessels other than single hull oil tankers (see Chapter 6). For some of the segments/size ranges, only very limited information is available. Life time expectancy for these has been based on the limited information available and on an expert assessment. For the projection presented in the next chapter, it has been assumed that the lifetimes of all other vessels than single hull oil tankers are constant during the forecast period.

A summary of the findings on the average life time expectancy is shown in the table below. The average life time expectancy by vessel type and size group is presented in appendix 3.

As shown, oil tankers have on average been in operation for 26.1 years, which is slightly more than bulk carriers, container vessels and other cargo vessels. There is a tendency that small vessels on average are in operation longer compared to large vessels. For example, handysize oil tankers (40-60,000 DWT) have on average been in operation for 27.5 years compared to 23.9 years for VLCC/ULCCs (>200,000 DWT) (see appendix 3 for details).

Table 5.6 Average historical life times by type of vessel

Main vessel type	Historical average lifetime (years)
Oil tanker	26.1
Other tanker	26.1
Bulk carrier	25.7
Container	25.4
Gas	29.3
Passenger/ro-ro/vehicle	27.1
Other cargo vessel	25.9
Non-cargo vessel	27.7

The figure below indicates that it is reasonable to assume that the average lifetime is constant over time as no trend can be observed historically (the last 10 years), although a trend for the last 3-4 years suggests slightly longer average life time compatible with positive freight markets.

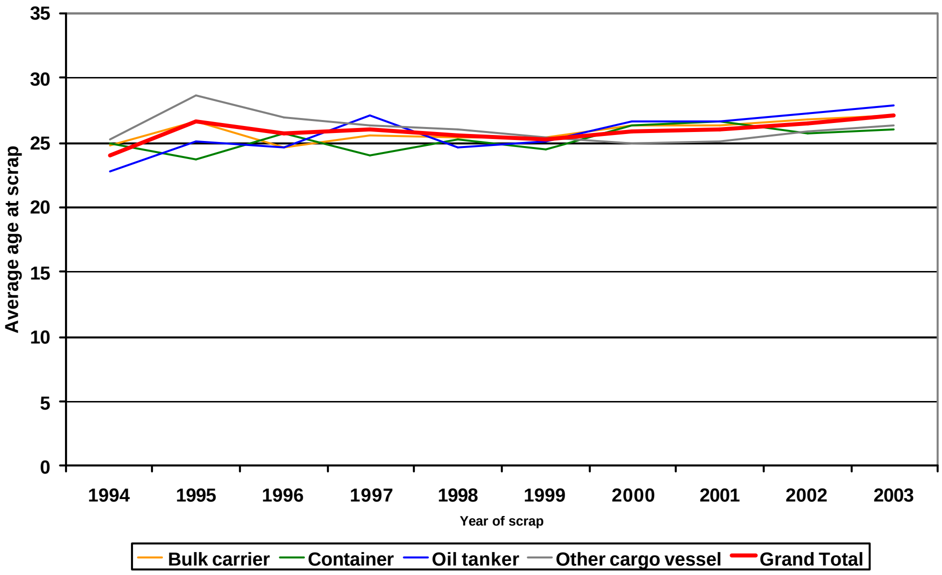


Figure 5.4 Average age at scrap by year of scrapping

5.4 Ship scrapping prices

The price obtainable when a vessel is sold for scrap reflects the balance of demand and supply in the demolition market. The figure below shows the developments in volume and prices over the last decade.

If the price obtainable in the demolition market is a significant driver for the decision of the ship owners on when to scrap, there must be a close and positive correlation between prices and volumes of decommissioning. However, prices and volumes are actually negatively correlated, i.e. when volumes go down, prices increase. This indicates that other factors (for example the developments in the freight market) are more important for the ship owners decision (this is discussed in the next section).

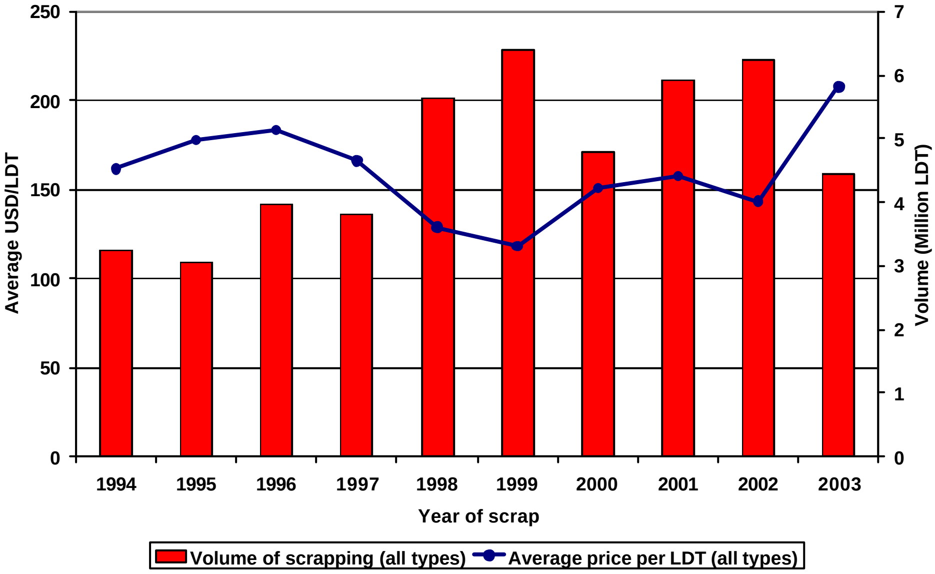


Figure 5.5 Average scrap price and volumes of scrap by year of scrapping (all types)

Figure 5.6 below shows the average scrap prices over time for selected countries.

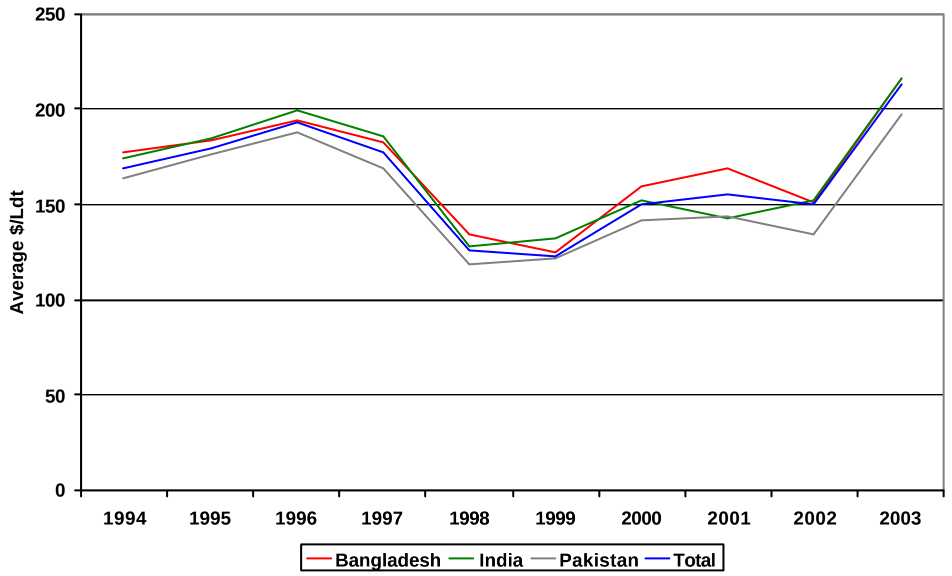


Figure 5.6 *Scrap prices - Selected countries (to allow comparison only oil tankers are included)*

Figure 5.6 shows that the price trend is remarkably similar across countries, with only minor differences in the prices paid by the ship scrappers at a given point in time. This reflects that the ship scrappers are operating in a global market.

5.5 Influence of key drivers

In Chapter 4, the key drivers for demand and supply were identified. The importance of these is evaluated in the following sections, i.e. it is discussed which factors are important in determining the price of vessels sold for scrap and the volume of decommissioning of ships.

The results are used to explain why vessels have historically been scrapped in developing countries in Asia rather than in the developed countries. Furthermore, the results are used for the scenario analyses in Chapter 6.

5.5.1 Freight rates

There is a close connection between the freight market and the demolition market. The demolition market works as a buffer for the demand/supply-balance in the freight market.

When the growth in demand for sea transport services outpaces the supply growth (fleet growth), the freight rates increases and the scrapping moderates. Similarly, when an overcapacity in the freight market develops during a downturn in the business cycle, freight rates decline and the activity in the demolition market increases. This point is illustrated for oil tankers in Figure 5.7

which shows an index of average spot rates[27] and the volume of scrap of oil tankers (on a yearly basis).

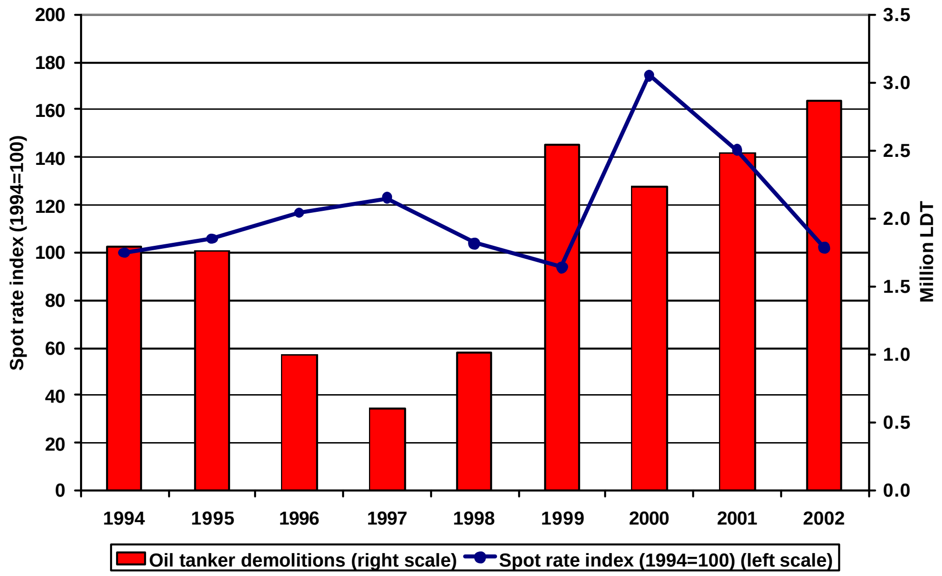


Figure 5.7 Spot rates and demolition volumes (Oil tankers)

Demolition volumes declined while rates increased from 1994 to 1997 and volumes increased from 1998 to 1999 while spot rates declined. From 1999 to 2000, volumes declined slightly when the spot rates again showed an increasing trend and increased from 2000 to 2002 when the spot rates declined markedly. Evaluated on a monthly basis, the correlation between the rate level and the volumes is even more pronounced (see for example (Greek Shipping Cooperation Committee, 2003) and (Poten & Partners, 2004)).

Combining the information shown in Figure 5.5 and Figure 5.7, it appears that the most important key driver for determining the scrap price is the freight rates. The empiric data confirms the mechanisms explained in Chapter 4. The higher the freight rates, the less ships for scrapping and the higher the scrap price. As the tendency is so clear, it seems like the fluctuations and influences of all other key drivers are only of minor importance for the scrap price compared to the influence of the freight rate.

5.5.2 Steel prices

Steel scrap from decommissioning of ships is a valuable asset. In the developing countries, the large pieces of steel is heated and re-rolled into rods for sale in the local construction industry, whereas the small parts are melted down. In the western countries the market for re-rolled steel is smaller and therefore

[27] See appendix 4 for details

scrap steel is generally completely melted down to make fresh steel (Stopford, 2000).

The global decommissioning volume of ships depends, in theory, on the price of recycled steel. However, it can be concluded that the relationship between the number of ships for decommissioning and the price of recycled steel is not very strong, as Figure 5.5 shows the average scrap price is not positively correlated with scrapping volumes. This indicates that the scrapping price (and therefore also the price of steel) is not really an important driver for ship owners' decision on when to scrap. The freight rates and thus potential earning from keeping a ship in operation is far more important. However, under extreme circumstances it can not be ruled out that the steel price can have some impact on the volumes of scrapping (see Section 5.6).

Although it appears that the steel price is not very important in relation to the decision on *when* to scrap, it is important in relation to the ship owners' decision on *where* to scrap.

Prices offered by various steel purchasers differ quite remarkably across regions of the world and vary considerably over time. This is due to differences in costs as well as differences in demand (and supply) of recycled steel in that particular region. Prices depend mostly on the demand from the construction industry.

According to BIMCO (BIMCO, 2002), steel from ships comprises less than 2% of the total consumption of recycled steel world wide. However, for some of the countries engaged in scrapping, the raw materials supplied to the steel-industry for both re-rolling and re-melting can be a considerable part of the steel used in the country. The ship scrapping is in these countries often viewed upon as a cost-effective way of importing steel. The steel industries in the large decommissioning countries can take significantly larger volumes of recycled steel from ships with out seriously affecting the market situation.

5.5.3 Labour costs

With the current practice used, ship breaking is a very labour-intensive industry. Labour costs therefore play a predominant role in determining where ships are scrapped and have been scrapped historically. The figure below shows the development in gross national income (GNI) per capita (a proxy for labour costs) over a 40 year period for selected countries.

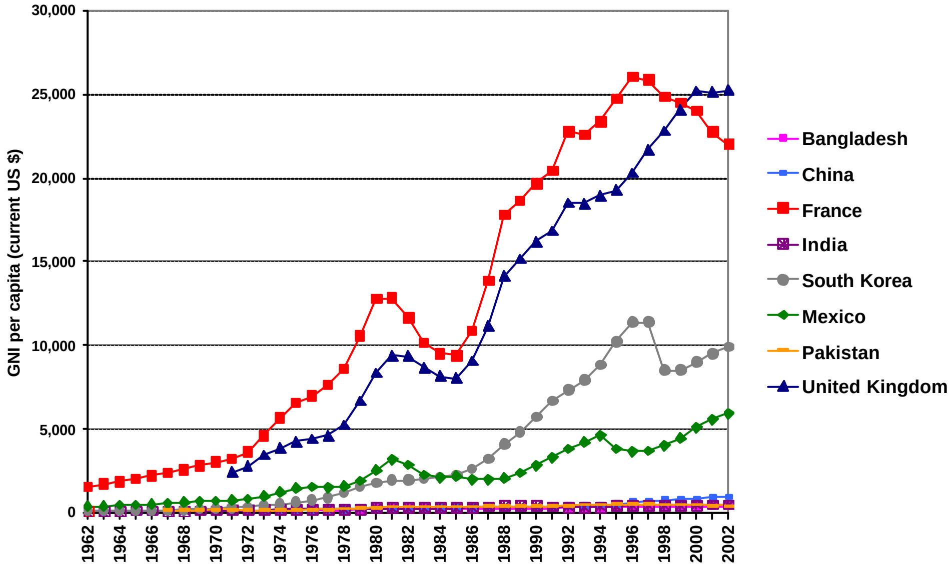


Figure 5.8 GNI per capita for selected countries (current US $) from 1962-2002

The figure shows huge differences in the gross national income per capita for the selected countries, e.g. the GNI per capita in France is more than 40 times higher than in India in 2002. This is an important reason why European countries are, almost, not operating in the ship scrapping market today.

The figure also shows that the GNI per capita has increased substantially in Korea and Mexico. This explains why ship scrapping moved from these countries to the countries of Pakistan, India, Bangladesh and China, which throughout the period have had very low GNI per capita compared to other countries in the world.

5.5.4 Other key drivers

Other items and materials

Although scrap steel makes up most of the value of a decommissioned ship, it also provides valuable second hand material (copper, aluminium) and equipment (engines, generators, cranes etc.) for re-use locally and for export. Generally, these items and materials account for approximately 3-4% of the total value of a scrapped ship (Danish EPA, 2003). The market for "other items" is better in the developing countries than in the developed countries, where technological standards and quality are generally higher (Stopford, 2000). Again this makes the developing countries more attractive for decommissioning of ships.

Health, safety and environmental issues

Given the currently applied practice of ship breaking, costs associated with health, safety and environmental issues plays only a minor role compared to labour costs and steel prices. However, it still explains a small part of the cost difference between developed countries and some countries in Asia.

In ship breaking countries in Asia, costs associated with health, safety and environmental standards are negligible, as these are not an issue at most scrapping facilities. However, for tankers to be broken in India a “gas-free”-certificate is required. This may be a factor influencing the demolition of the large tankers. Bangladesh and Pakistan, who claims the lion's share of the VLCC and ULCC market, do not have this requirement.

5.5.5 Conclusion on key drivers

Figure 5.9 below summarises the main findings on the key drivers.

Freight rates appear to be the most important driver for the ship owners' decision on when to supply vessels to the ship scrappers. Furthermore, the costs of keeping the vessel in operation (running costs, surveys etc.) play a prominent role.

This indicates that the supply of vessels to the ship scrapper is relatively inelastic to the price obtainable when a vessel is sold for scrap (the supply curve is vertical). Only under extreme circumstances may the price offered by the ship scrapper influence the volume of scrapping. This view is supported by the analysis in Section 5.4, which shows that there is no positive correlation between prices and volumes in the demolition market. The price offered by the ship scrappers depends on numerous factors, including the market demand for steel, labour costs etc.

Finally, international regulation (for example phase out schemes) is important for the supply of vessels to the ship scrapping industry. This is the main focus of the next chapter.

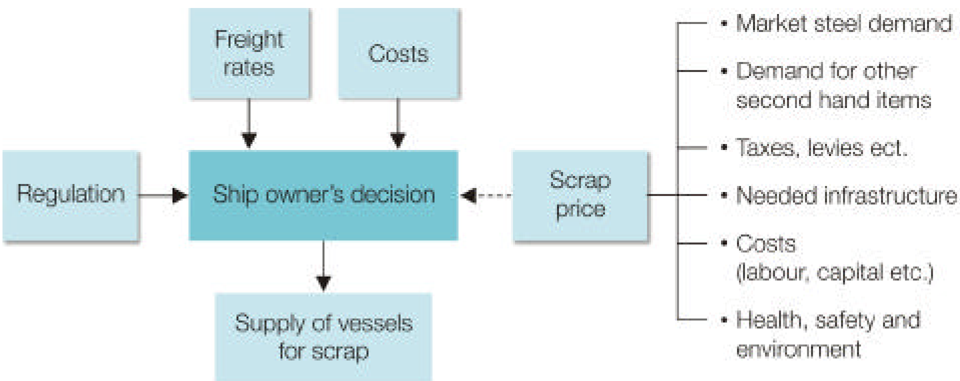


Figure 5.9 Key drivers for the supply of vessels to the ship scrapping industry

5.6 Recent developments

During the last two years, the scrap prices have tripled from a level of 125 USD/LDT in the beginning of 2002, to a level close to 400 USD/LDT in the beginning of 2004.

This can primarily be explained by two factors:

1 The almost insatiable need for steel for the construction industry in China has increased the demand for ships for ship scrapping.

2 The strong freight markets in almost all shipping segments have limited the supply of vessels for decommissioning.

The high scrap prices have, due to the strong freight markets, not resulted in an increase in the scrapping activity. In fact, very few vessels have been scrapped in the early months of 2004. This illustrates the point that the freight rates are far more important for the decision on when to scrap compared to the price offered by the ship scrappers.

However, the extremely high scrapping prices could, as pointed out by Poten & Partners (2004, page 4) have an influence on volumes if the freight markets weakens: 'While scrap prices are high, tanker owners with older tonnage are probably wise to keep trading in the spot market. But the slightest sign of weakness grab the 400 USD/ton and run with it'. It is worth noting that such a reaction to a weakening in the freight markets, could lower the prices offered in the ship scrapping market due to an increased supply of vessels for scrap.

6 Projections of the future volume and capacity of ship scrapping

This section presents the analyses of the outlook for future volumes of ship scrapping and discusses this in relation to the capacity of the ship scrapping yards.

The analysis is based on two main scenarios for the phase out of single hull oil tankers and general estimates of the future scrapping of other types of vessels.

First, the two scenarios for the phase out of single hull oil tankers are described in detail followed by a presentation of the methodological approach. Then, the projections for the main analysis are presented. The main analysis is supplemented by various sensitivity analyses. Finally, the projections are discussed in relation to the capacity of the ship scrapping industry.

6.1 Scenarios

The assessment of the possible developments is based on an analysis of two different scenarios for the phase out of single hull oil tankers:

1 *Base scenario (IMO MARPOL 13G)*: The Base scenario analyses the possible developments under the IMO MARPOL 13G regulation, i.e. this scenario analyses the possible future developments if no other regulation than the IMO MARPOL 13G regulation had been implemented.

2 *Accelerated phase out scenario (EC 1726/2003 and Revised MARPOL Annex 1)*: This scenario analyses the consequences of EC regulation No. 1726/2003 of 22 July 2003 and the Revised Annex 1 of MARPOL of 2003.

Given the overruling of EC regulation 417/2002 of 18 February 2002 by EC 1726/2003, the possible consequences of the former regulation are not analysed.

6.1.1 Changes in the regulation

The amendments to Annex 1 of MARPOL 73/78 in the EC regulation No. 1726/2003 of 22 July 2003 contain several changes compared to the previous regulation of IMO 13G and to the EC regulation No. 417/2002 of 18 February 2002. Compared to the IMO 13G these include:

- Accelerated phase out scheme with 2005 (previous 2007) as the principal cut-off date for category 1 tankers and 2010 (previous 2015) for category 2 and 3 tankers
- CAS is to be made applicable for all single hulled tankers from the age of 15 years
- Exemption for category 2 and 3 tankers with satisfactory CAS results, which are allowed to operate to the date on which the vessel reaches 25 years or 2015 whichever is sooner
- Exemption for category 2 and 3 tankers with double sides or double bottoms, which are allowed to operate to the date on which the vessel reaches 25 years
- Heavy grades of oil must not be carried in single hull tankers of >5,000 DWT after 5th April 2005
- Tankers carrying heavy grades of oil (600-5,000 DWT) must comply with regulation 13G by there anniversary in 2008.

6.2 Methodology for projection of future scrapping volumes

The methodology applied for the statistical analysis of future decommissioning volumes is described below. First, the approach to the estimation of the future decommissioning volumes of single hull oil tankers is described. Second, the methodology for estimating future decommissioning of ships other than single hull oil tankers is described.

As the focus in this report is on the demolition market, the most relevant unit is LDT. Accordingly, all figures shown in this section is measured in LDT. However, many other reports (which focus on the freight markets) refer to the numbers in DWT. Consequently, the key figures are here, for the purpose of comparison, also presented by number of DWT (and number of vessels).

Note that the analysis focuses on vessels of 2,000 DWT and above.

6.2.1 Single hull oil tankers

The analysis of the consequences of the relevant regulation for single hull oil tankers is a complex matter due to the complexity of the regulation, but also due to the limited information available. Hence, simplifications and assumptions are necessary when analysing the impact of the regulation. The assumptions and delimitations made are described here.

It is important to note that single hull tankers consist of both single skin oil tankers (SS) and oil tankers equipped with double sides (DS) or double bottom (DB). The regulation does, as mentioned, distinguish between these.

First of all, simplifications are necessary when dividing the ships into the three categories identified in the regulation:

- Category 1: This category covers single hull tankers over 20,000 DWT carrying crude oil, fuel oil, heavy diesel oil or lubricating oil as cargo, and of single hull tankers over 30,000 DWT carrying oil other than the above, which do not comply with the requirements for protectively located segregated ballast tanks. As the information on whether a given vessel complies with the requirements for protectively located ballast tanks is not available and the information on type of cargo is only indirectly covered, it is necessary make simplifications. Accordingly, for practical purposes this segment has been defined as single hull oil tankers over 20,000 DWT built in 1981 or earlier.

- Category 2: This category covers single hull tankers over 20,000 DWT carrying crude oil, fuel oil, heavy diesel oil or lubricating oil as cargo, and of single hull tankers over 30,000 DWT carrying oil other than the above, which do comply with the requirements for protectively located segregated ballast tanks. Due to the above mentioned limitations of the data material, this segment has been defined as single hull oil tankers over 20,000 DWT build in 1982 or after.

- Category 3: This category covers single hull oil tankers over 5,000 DWT, but less than specified under the two first categories. In line with the above, this segment has been defined as single hull oil tankers between 5,000 DWT and 20,000 DWT. For some of the vessels in this category, no indications are available on the hull type. In the analysis these vessels are treated as single skins.

It is noteworthy that the implications for the results of not taking into account the 20,000/30,000 DWT limits are small, as only around 4% (measured as DWT) of oil tankers are between 20,000 and 30,000 DWT.

6.2.2 Other shipping segments

The estimates of the future decommissioning volumes of other vessels than single hull oil tankers are prepared on the basis of the *estimated life time expectancy and the age profile of the current fleet*. Practically, the estimates are the results of a four step procedure:

1. The *age profile* of the existing fleet for each shipping segment is estimated.

2. The *decommissioning frequency function*, which shows the share of vessels scrapped at a certain age, is estimated for each segment. For statistical analysis, the decommissioning frequency function is estimated on the basis of a three-parameter Weibull fit by varying the mean value for each segment in accordance with the average lifetime observed historically[28].

[28] The Weibull distribution is widely used in reliability and life data analysis due to its versatility. Depending on the values of the parameters, the Weibull distribution can be used to model a variety of life behaviours

3 The *conditional decommissioning frequency function* is estimated on the basis of the *decommissioning frequency function.* The conditional decommissioning function expresses the probability that a vessel is scrapped in the following year conditional on being in operation at the beginning of the year.

4 Combining the estimated age profile and the fitted conditional decommissioning frequency function for each segment, estimates of the future decommissioning volumes are obtained. By adding these for all segments, the aggregate estimates of future volumes of scrapping of all other vessels than single hull oil tankers are reached.

A summary of the age profile of the current fleet of "other types" is shown in the table below (see appendix 5 for same table in number of vessels and DWT). Note that for the statistical analysis, the age profile is estimated in one-year intervals.

The table mirrors the high level of newbuilding activity seen in some segments during the last years. For example, close to 80% of *other tankers* (this segment includes double hull oil tankers and tankers trading non-oil products) are less than ten years old. This reflects the ordering boom seen in the wake of the phase out plan for single hull oil tankers. Almost the same pattern is seen for the container segment. Here, more than 60% of the vessels are less than 10 years old. The high level of newbuilding of container vessels reflects that this segment has experienced a high growth of cargo volumes. As argued earlier the high fleet growth will not be directly mirrored in the level of scrapping volumes over the coming years. The effect will be seen 20-30 years after the delivery of the vessels. Note for example that the average age of *other tankers* and *container vessels* are only 9.7 and 11.5 years, respectively. The corresponding figures for the average historical life time are 25-26 years.

In total, the current fleet of vessels other than single hull oil tankers corresponds to approximately 189.2 million LDT.

Table 6.1 Age profile of current fleet (Million LDT and share of fleet)

Segment		0-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25+ years	Total	Average age	Average hist. life
Other tanker	mLDT	14.3	10.9	4.6	1.3	0.6	0.6	32.3	9.7	26.1
	%	44.3%	33.8%	14.3%	3.9%	1.7%	2.0%	100.0%		
Bulk carrier	mLDT	11.1	14.6	8.4	9.3	12.1	7.8	63.3	15.9	25.7
	%	17.5%	23.0%	13.2%	14.8%	19.1%	12.3%	100.0%		
Container	mLDT	13.7	13.9	6.9	4.5	3.5	2.3	44.8	11.5	25.4
	%	30.6%	31.0%	15.4%	10.0%	7.8%	5.1%	100.0%		
Gas	mLDT	1.7	1.5	1.5	0.5	1.3	1.9	8.4	14.8	29.3
	%	20.5%	17.5%	18.3%	5.6%	15.6%	22.5%	100.0%		
Passenger/ro-ro/vehicle	mLDT	1.7	2.2	1.1	2.0	2.8	3.3	13.1	17.5	27.1
	%	13.1%	16.5%	8.6%	15.5%	21.0%	25.4%	100.0%		
Other cargo vessel	mLDT	2.4	4.6	2.9	3.4	4.7	6.8	24.8	17.4	25.9
	%	9.9%	18.5%	11.6%	13.7%	19.1%	27.2%	100.0%		
Non-cargo vessel	mLDT	0.7	0.6	0.2	0.2	0.3	0.5	2.5	11.2	27.7
	%	28.1%	26.1%	6.4%	6.9%	13.7%	18.9%	100.0%		
Total	mLDT	45.7	48.2	25.6	21.2	25.3	23.2	189.2		
	%	24.2%	25.5%	13.5%	11.2%	13.4%	12.3%	100.0%		

The empirical decommissioning frequency function and conditional decommissioning frequency function are shown in Figure 6.1.

As mentioned the decommissioning frequency function shows the share of vessels scrapped at a certain age. For example, around 14% of the vessels scrapped were scrapped at the age of 25 years. The conditional frequency function shows, for example, that given a vessel has reached the age of 28 the probability that the vessel is scrapped in the following year is around 30%.

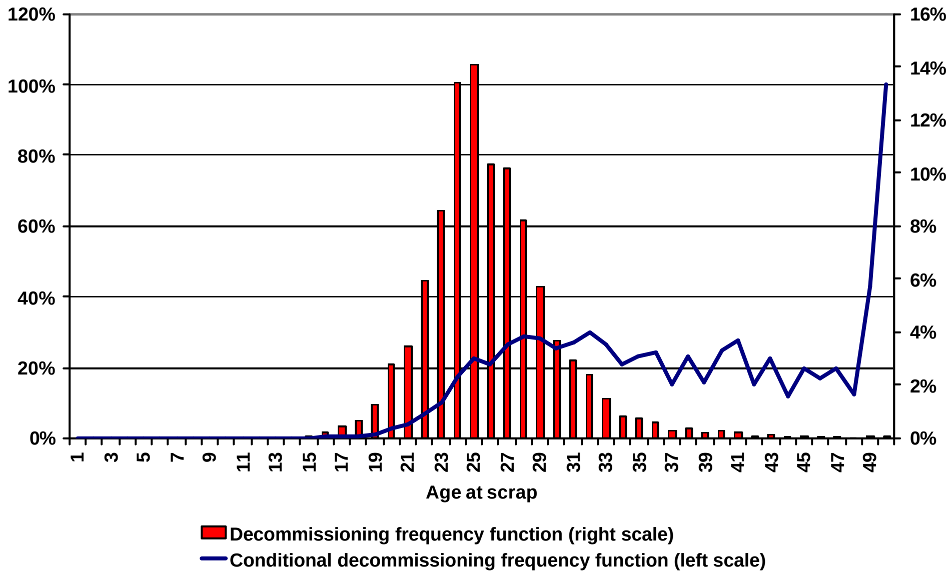


Figure 6.1 Empirical decommissioning frequency function and conditional decommissioning frequency function (all types of vessels)

6.2.3 Assumptions and delimitations

The assumptions and delimitations made in relation to the projections are listed below. The importance of the key assumptions for the estimates of future scrapping volumes is analysed in Section 6.4.

- The special rules relating to vessels between 600 DWT and 5,000 DWT have not been taken into account, i.e. only single hull oil tankers above 5,000 DWT have been included in the analysis (single hull oil tankers under 5,000 DWT are treated as *other tankers*).

- The analysis takes into account the special rules for oil tankers of category 2 or 3 equipped with double sides or double bottoms. Under the Accelerated phase out scenario it is assumed that these will continue to be operated until 2015 or the year in which the ship reaches the age of 25, whichever is sooner. For the Base scenario, the final cut-off date for oil tankers of category 2 or 3 equipped with double sides or double bottoms is 2021. It is assumed that all oil tankers listed as double bottom/double side comply with the requirements listed in the regulation.

- It is assumed that all phased out ships are decommissioned, which means that it has been assumed that these are not used for any other purpose at the end of there trading life. Tankers could potentially be rebuilt to serve as, for example, FPSOs (floating production storage and off-loading) or FSOs (floating storage and off-loading).

- Contrary to the regulation applicable for the Base scenario (IMO MARPOL 13G), the relevant EC 1726/2003 regulation is only applicable for European countries. However, the newly adopted Revised IMO

MARPOL 13G regulation, which is almost similar to the EC 1726/2003 regulation, is applicable world wide. Accordingly, it assumed in the main analysis that the EC 1726/2003 applies for all vessels. Note that there are a few important differences between in the EC 1726/2003 regulation and the Revised IMO MARPOL 13G regulation, which are ignored in the main analysis:

  - The date of entry force in the EC and IMO regulation differs. It is assumed that all single hull tankers are phased out according to the EC date of entry force.
  - In the new IMO regulation, tankers can be exempted from the phase out dates if certain conditions are fulfilled. It is very difficult to predict how much this exemption will be used. Therefore, for analytical purposes it has simply been assumed that it is not used by the ship owners.

- It is assumed that single hull oil tankers are sold for demolition at the dates specified under the relevant regulation. In reality, the market forces might imply that the ship owners decide to supply some of their vessels to ship scrappers before that date.

- The consequences of the new regulation relating to the tankers carrying heavy grade of oil have not been analysed. Possible implications would be very difficult to project and the results would heavily depend on assumptions that would have to be made in order to analyse the impacts.

- Tankers fulfilling the conditions in paragraph 1(c) of 13G are considered as double hulls for both the EC Regulation and the revised MARPOL. This means that this special condition exempting tankers fulfilling specific requirements for minimum distances between the cargo tank boundaries and the ship side and bottom plating has not been taken into account in the analysis.

It should be noted that by applying the approach described above of estimating the future decommissioning volumes by year (e.g. when ships are scrapped), the projections will only reflect the overall trend in volumes. Moreover, the projections will not reflect the ups and downs of the scrapping market business cycle that comes from fluctuating freight rates etc. However, using the estimated age profile and the fitted conditional decommissioning frequency function to estimate the future decommissioning volumes the trend in the medium and long term will be reflected.

The consequences of this approach with regards to the estimated peak volumes in years 2010 and 2015 are further discussed in Section 6.4 and Section 6.6.

6.3 Future scrapping volumes

After a short presentation of the existing fleet of single hull oil tankers, the estimates of future scrapping volumes are presented. The existing size of the fleet and scrapping volumes have been calculated and expressed by the number of ships, DWT and LDT. For the convenience of the reader most tables in the text below refer to LDT, which is the unit relevant for the scrapping industry. However, tables presented by the number of ships and DWT can be found in appendix 6 and 7. The tables included in the appendix are also commented in the text below.

6.3.1 The fleet of single hull oil tankers

The composition of the existing fleet[29] of single hull oil tankers is shown by year of delivery, category and hull type in the table below. The total fleet of single hull oil tankers represents 24.1 million LDT (2,256 vessels/129.5 million DWT), of which 7.1 million LDT (523 vessels/35.0 million DWT) are category 1 tankers. The equivalent numbers for category 2 and 3 tankers are 14.6 million LDT (804 vessels/85.7 million DWT) and 2.5 million LDT (929 vessels/8.8 million DWT), respectively. The corresponding tables by DWT and number of vessels are presented in appendix 6. Note that no distinction is made between single hull oil tankers equipped with double bottom (DB) and single hull oil tankers equipped with double sides (DS) as these are treated equal in the regulation.

[29] Per October 1 2003

Table 6.2 The fleet of single hull oil tankers by category, hull type and year of delivery (Million LDT)

Build year	CAT 1			CAT 2			CAT 3			Total
	DB/DS	SS	Total	DB/DS	SS	Total	DB/DS	SS/Missing	Total	
Pre 1970	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.3
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
1972	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1973	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.3
1974	0.0	0.4	0.4	0.0	0.0	0.0	0.0	0.1	0.1	0.5
1975	0.1	0.5	0.5	0.0	0.0	0.0	0.0	0.1	0.1	0.7
1976	0.1	1.0	1.1	0.0	0.0	0.0	0.0	0.1	0.1	1.2
1977	0.1	0.6	0.7	0.0	0.0	0.0	0.0	0.1	0.1	0.8
1978	0.2	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.6
1979	0.1	0.7	0.8	0.0	0.0	0.0	0.0	0.1	0.1	0.9
1980	0.2	0.8	1.0	0.0	0.0	0.0	0.1	0.1	0.2	1.2
1981	0.4	1.0	1.4	0.0	0.0	0.0	0.1	0.1	0.1	1.6
1982	0.0	0.0	0.0	0.3	0.8	1.2	0.1	0.1	0.1	1.3
1983	0.0	0.0	0.0	0.3	0.6	0.9	0.1	0.1	0.1	1.1
1984	0.0	0.0	0.0	0.2	0.5	0.7	0.1	0.1	0.2	0.8
1985	0.0	0.0	0.0	0.3	0.4	0.7	0.1	0.1	0.2	0.9
1986	0.0	0.0	0.0	0.3	0.7	1.0	0.1	0.0	0.1	1.2
1987	0.0	0.0	0.0	0.3	0.5	0.8	0.0	0.0	0.1	0.9
1988	0.0	0.0	0.0	0.3	0.7	1.0	0.0	0.1	0.1	1.1
1989	0.0	0.0	0.0	0.3	0.9	1.3	0.0	0.0	0.1	1.3
1990	0.0	0.0	0.0	0.2	1.1	1.3	0.0	0.0	0.1	1.4
1991	0.0	0.0	0.0	0.3	1.1	1.4	0.0	0.0	0.1	1.5
1992	0.0	0.0	0.0	0.3	1.3	1.6	0.0	0.0	0.1	1.6
1993	0.0	0.0	0.0	0.2	1.1	1.3	0.0	0.1	0.1	1.4
1994	0.0	0.0	0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.8
1995	0.0	0.0	0.0	0.0	0.5	0.6	0.0	0.0	0.0	0.6
1996	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1.3	5.7	7.0	3.4	11.2	14.6	0.9	1.6	2.5	24.1

The composition of the fleet of oil tankers (including double hull) are shown in the figure below in million DWT. The graph shows a shift in the tendency to build double hull oil tankers during 1991-1995. Since 1996, virtually no single hull oil tankers (SS/DB/DS) have been built.

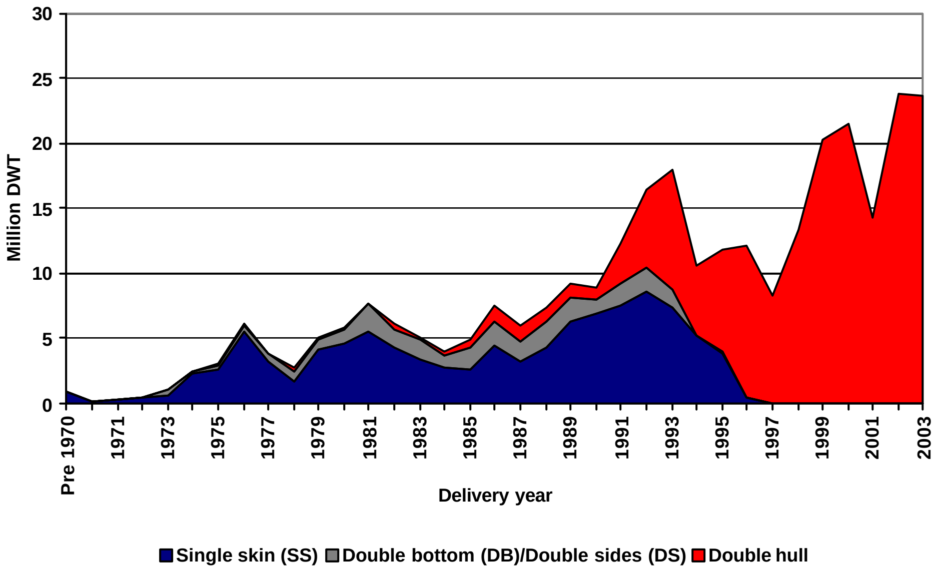


Figure 6.2 The age profile of the total oil tanker fleet (Million DWT)

6.3.2 Base scenario (IMO 13G)

It is, as mentioned, assumed that single hull tankers are phased out at the dates specified in the relevant regulation. In the Base scenario, single hull tankers are being decommissioned at the latest point in time according to the IMO 13G regulation (MEPC 46 of 27 April 2001).

The estimated phase out arising from the IMO 13G regulation is shown in the table below in LDT (and in appendix 7 by number of ships and DWT). In the Base scenario scrapping volumes are estimated to peak in 2015 with an estimated volume of 7.7 million LDT (49.3 million DWT/ 442 vessels). These findings are close to the estimates of future scrapping volumes found by BIMCO (2001), INTERTANKO (2002) and the Greek Shipping Co-operation Committee (2003). BIMCO (2001) finds that around 8 million LDT of single hull oil tankers will be phased out in 2015 according to the "old" IMO 13G. The comparable figures for the Greek Shipping Co-operation Committee (2003) and INTERTANKO (2002), which refer to the number in DWT, are 48 million DWT[30] and 47.2 million DWT, respectively.

The table below also presents data on the average age at phase out. Note that the average age at phase out for the Base scenario is higher, especially during

[30] Reading from graph.

2003-2007, compared to the average age at scrap observed historically (see Table 5.6). Accordingly, a higher level of demolition than those indicated below could be foreseen in the coming few years - driven by market forces[31].

Table 6.3 Oil tanker phase out by IMO category, hull type and year of phase out - Base scenario (Million LDT)

Phase out year	CAT 1			CAT 2			CAT 3			Total	Average age at scrap
	DB/DS	SS	Total	DB/DS	SS	Total	DB/DS	SS/Missing	Total		
2003	0.1	0.4	0.5	0.0	0.0	0.0	0.0	0.3	0.3	0.8	33.3
2004	0.1	0.9	0.9	0.0	0.0	0.0	0.0	0.2	0.2	1.2	29.4
2005	0.2	1.6	1.8	0.0	0.0	0.0	0.0	0.1	0.1	2.0	28.6
2006	0.5	1.9	2.3	0.0	0.0	0.0	0.0	0.1	0.2	2.5	27.0
2007	0.4	1.0	1.4	0.0	0.0	0.0	0.1	0.2	0.3	1.7	26.3
2008	0.0	0.0	0.0	0.3	0.8	1.2	0.1	0.1	0.1	1.3	26.0
2009	0.0	0.0	0.0	0.3	0.6	0.9	0.1	0.1	0.1	1.1	26.0
2010	0.0	0.0	0.0	0.2	0.5	0.7	0.1	0.1	0.2	0.8	26.0
2011	0.0	0.0	0.0	0.3	0.4	0.7	0.1	0.1	0.2	0.9	26.0
2012	0.0	0.0	0.0	0.3	0.7	1.0	0.1	0.0	0.1	1.2	26.0
2013	0.0	0.0	0.0	0.3	0.5	0.8	0.0	0.0	0.1	0.9	26.0
2014	0.0	0.0	0.0	0.3	0.7	1.0	0.0	0.1	0.1	1.1	26.0
2015	0.0	0.0	0.0	0.6	6.8	7.4	0.1	0.3	0.3	7.7	23.6
2016	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.3	25.0
2017	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.3	25.0
2018	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.2	25.0
2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0
2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0
Total	1.3	5.7	7.0	3.4	11.2	14.6	0.9	1.6	2.5	24.1	26.6

Note: Average age at scrap calculated as a weighted average of the ships phased out at the specific phase out year

The estimates of the future volumes of demolition of other types of vessels than single hull oil tankers are shown in the table below. The volumes of scrapping of other vessels than single hull oil tankers are estimated to fluctuate between around 5-8 million LDT/year during 2003-2018.

As can be seen, the future volumes of scrap of "other types" are estimated to start at a relatively high level for the next few years and then decline slightly until 2013. From 2014 and onwards, the volume of scrapping is estimated to show an increasing trend.

[31] The current very strong freight markets could, however, eliminate this effect.

The estimated pattern reflects the age profile of the current fleet. A relatively large number of vessels are rather old compared to the historically observed scrapping pattern. These can be expected to be scrapped within the coming few years. The anticipated increase from 2014 and onwards reflects the large volume of vessels delivered during the last 10 years. From 2014 and onwards, these vessels are maturing for scrap.

As actual volumes are sensitive to the developments in the freight market (see Section 5.5.1), these numbers should only be seen as indicative for the level of scrapping of other vessels than single hull oil tankers.

Table 6.4 Future volumes of demolition, All types, excluding single hull oil tankers (Million LDT)

Phase out year	Other tanker	Bulk carrier	Container	Gas	Passenger/ ro-ro/vehicle	Other cargo vessel	Non-cargo vessel	Total
2004	0.2	3.5	1.0	0.3	1.2	2.3	0.2	8.7
2005	0.2	3.2	1.0	0.3	1.0	1.9	0.1	7.7
2006	0.2	3.0	0.9	0.3	0.9	1.6	0.1	7.1
2007	0.2	2.9	0.9	0.3	0.8	1.4	0.1	6.7
2008	0.2	2.8	0.9	0.3	0.7	1.3	0.1	6.3
2009	0.2	2.7	0.9	0.3	0.7	1.1	0.1	6.0
2010	0.3	2.6	1.0	0.3	0.6	1.0	0.1	5.7
2011	0.3	2.4	1.0	0.3	0.5	0.9	0.1	5.5
2012	0.4	2.3	1.0	0.2	0.4	0.8	0.1	5.3
2013	0.5	2.2	1.1	0.2	0.4	0.8	0.1	5.2
2014	0.6	2.1	1.2	0.2	0.4	0.7	0.0	5.3
2015	0.7	2.1	1.3	0.2	0.4	0.7	0.0	5.4
2016	0.9	2.1	1.4	0.2	0.3	0.7	0.0	5.7
2017	1.1	2.2	1.6	0.2	0.3	0.7	0.0	6.1
2018	1.3	2.2	1.8	0.2	0.4	0.7	0.0	6.6

The figure below reflects the figures presented above on the estimated phase out of single hull oil tankers for the Base scenario and the estimates of future scrapping volumes of "other types" for the period 2003-2018.

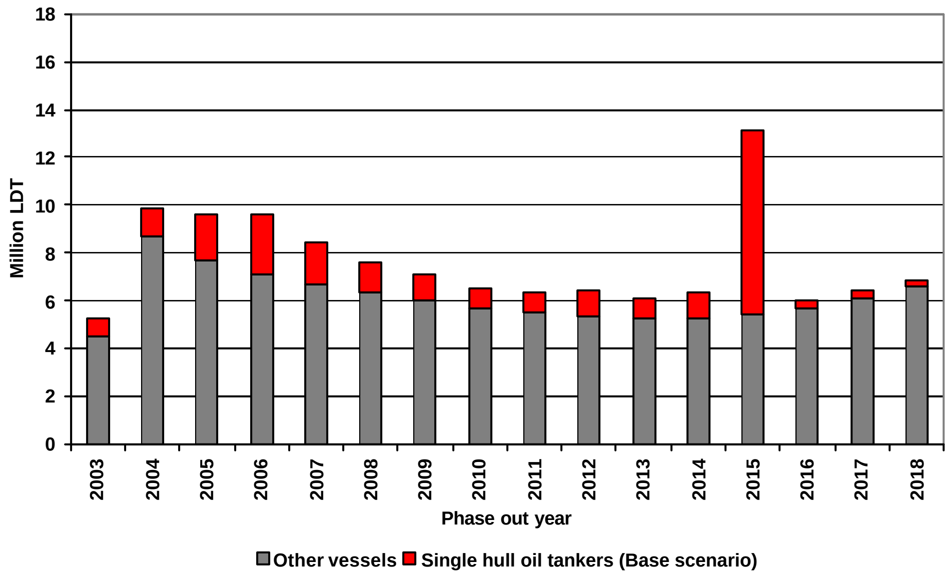


Figure 6.3 Total forecasted scrapping activity - Base scenario (Million LDT)

Figure 6.3 shows that the scrapping activity will peak in year 2015, which is the phase out year for the remaining single skin oil tankers of category 2 or 3. In 2015, around 13 million LDT are projected to be scrapped with single hull oil tankers accounting for close to 60% of the volume.

6.3.3 Accelerated phase out scenario

This section presents the estimates for the Accelerated phase out scenario. As for the Base scenario it is assumed that the single hull oil tankers are being sold for decommissioning at the dates specified in the regulation.

The estimates of future scrapping volumes are shown in the table below by LDT (and in appendix 7 by number of vessels and DWT).

In the Accelerated phase out scenario, the phase out of single hull oil tankers is estimated to peak in 2010, with an estimated volume of 11.0 million LDT (66.3 million DWT/ 784 vessels). This estimate is close to the projects of the Greek shipping Co-operation Committee (2003) and INTERTANKO (2003). The Greek Shipping Co-operation Committee estimates that 65.5 million DWT will be phased out in 2010 as a consequence of the newest EC regulation. The corresponding figure from INTERTANKO is around 67 million DWT[32].

Note that according to the scenario based on EC 1726/2003, quite a lot of the tankers (618 vessels) in operation by October 1 2003 should be phased out in 2003. This is a consequence of the assumption to use the EC 1726/2003 regulation and revised IMO MARPOL 13G as equal, which is not realistic until the

[32] Reading from graph

revised IMO MARPOL 13G has come into full force. A realistic scenario is that these find other places to operate and are scrapped in the coming years. To avoid introducing new assumptions and to keep the analysis as simple and transparent as possible, this artefact has not been counteracted.

Table 6.5 also includes numbers on the average age at phase out. As can be seen, the tankers phased out in 2010 have a significantly lower age at phase out compared to the average life time observed historically, and compared to the age at phase out for the Base scenario. Around 250 of the single hull oil tankers, which will be phased out in 2010, are less than 20 years of age at the time of phase out compared to an average historical life time of 26.1 years. More than 670 of the vessels phased out in 2010 are below the average historical life time at the time of phase out. This will have a significant negative impact on the economic situation of the owners, as the trading life of their vessels is shortened considerably.

Table 6.5 Oil tanker phase out by IMO category, hull type and year of phase out - Accelerated phase out scenario (Million LDT)

Phase out year	CAT 1			CAT 2			CAT 3			Total	Average age at scrap
	DB/DS	SS	Total	DB/DS	SS	Total	DB/DS	SS/Missing	Total		
2003	0.9	4.7	5.6	0.0	0.0	0.0	0.1	0.5	0.5	6.1	28.2
2004	0.4	1.0	1.4	0.0	0.0	0.0	0.0	0.1	0.1	1.5	24.0
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	28.0
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	27.4
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3	26.5
2008	0.0	0.0	0.0	0.3	0.8	1.2	0.1	0.1	0.1	1.3	26.0
2009	0.0	0.0	0.0	0.3	0.6	0.9	0.1	0.1	0.1	1.1	26.0
2010	0.0	0.0	0.0	0.4	9.7	10.1	0.2	0.6	0.8	11.0	21.4
2011	0.0	0.0	0.0	0.3	0.0	0.3	0.1	0.0	0.1	0.4	25.0
2012	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.3	25.0
2013	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.4	25.0
2014	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.4	25.0
2015	0.0	0.0	0.0	1.1	0.0	1.1	0.1	0.0	0.1	1.2	23.3
Total	1.3	5.7	7.0	3.4	11.2	14.6	0.9	1.6	2.5	24.1	24.8

Note: Average age at scrap calculated as a weighted average of the ships phased out at the specific phase out year

Figure 6.4 below shows the estimates of the total volumes of scrapping by taking into account the estimates for "other vessels" (which are the same for the Base scenario and the Accelerated phase out scenario).

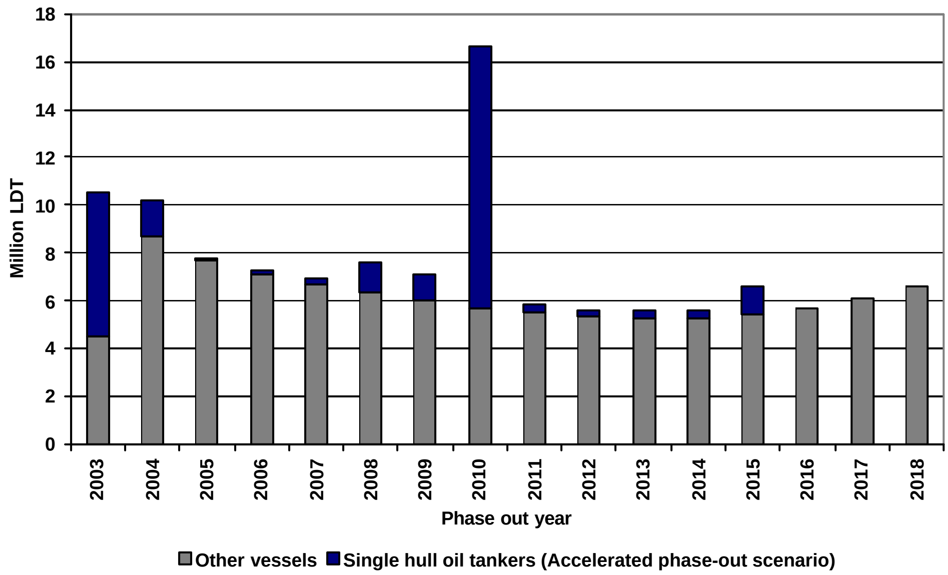


Figure 6.4 Total forecasted scrapping activity - Accelerated phase out scenario (Million LDT)

Figure 6.4 shows that the scrapping activity will peak in year 2010, which is the phase out year for the remaining single skin oil tankers of category 2 or 3. More than 16 million LDT are projected to be scrapped with single hull oil tankers accounting for approximately two thirds of the volume.

How the accelerated phase out of single hull oil tankers will affect the freight market is difficult to assess, as this depends on the speed of replacement. A close look at the order book gives an indication. At the end of 2003, the order book of oil tankers contained 880 vessels of 77.3 million DWT, of which around 330 vessels (of around 29 million DWT) were due for delivery in each of the years 2004 and 2005. Given an estimated peak volume phase out of 66.3 million DWT in 2010, it appears likely that the phased out vessels will be possible to replace. Accordingly, it is not anticipated that a shortage of oil tankers are likely as a consequence of the accelerated phase out scheme. However, the need of replacement will (and probably already has) put an upward pressure on the newbuilding prices.

6.3.4 Comparison of the phase out scenarios

Figure 6.5 shows a comparison of impacts of the two relevant phase out schemes for the phase out of single hull oil tankers by LDT (and by DWT in appendix 7).

The Accelerated phase out scenario implies that the peak of the phase out of single hull oil tankers comes in 2010 compared to 2015 for Base scenario and that the peak volumes are around 40% higher.

To put the figures into perspective, the average level of deliveries of oil tankers per year has, during the last ten years, been in the region of 2.7 million LDT or 16 million DWT. Hence, the estimated peak volume of 2015 for the Base scenario is approximately equivalent to three years of deliveries. The peak volume of 2010 for the Accelerate phase out scenario is then equivalent to around four years of oil tanker deliveries.

In relation to the average level of scrapping of oil tankers seen the last ten years (1.9 million LDT), the peak volumes of the Base scenario is around four times higher, whereas the peak volume of the Accelerated phase out scenario is 5-6 times higher.

It is also clear that the timing of the Accelerated phase out scheme is more uneven compared to the Base scenario. Around 70% of the tonnage is, according to the schedule, phased out in two years, namely 2003 and 2010.

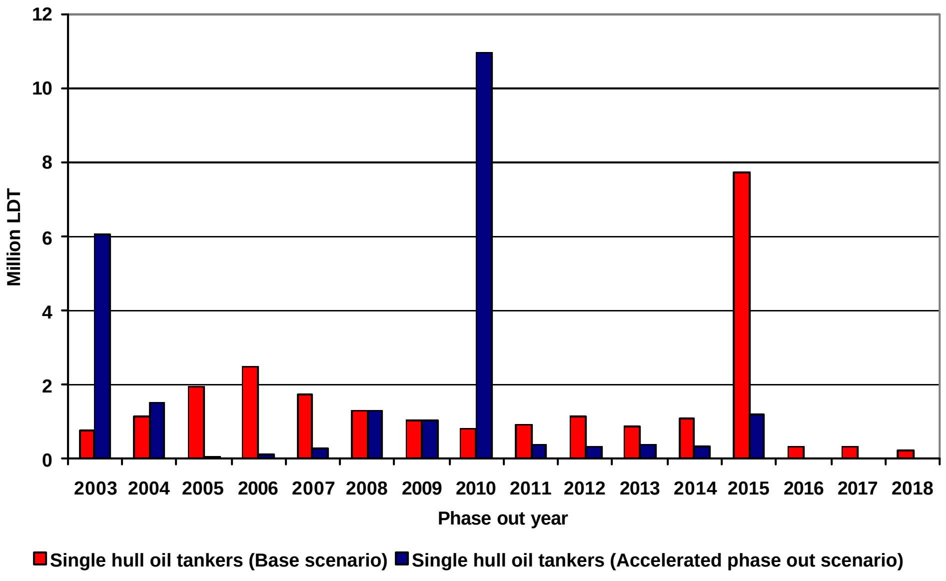


Figure 6.5 Comparison of phase out schemes (million LDT) (Single hull oil tankers)

Figure 6.6 shows a comparison of the impacts of the two regulations taking into account the estimates of future demolition of "other vessels". It is these figures that are of interest in relation to the capacity of the ship scrapping industry. Accordingly, it is the estimated peak volumes of 16.7 million LDT and 13.2 million LDT for the Accelerated phase out scenario and the Base scenario, respectively that are to be compared with the estimated capacity of the ship scrapping industry.

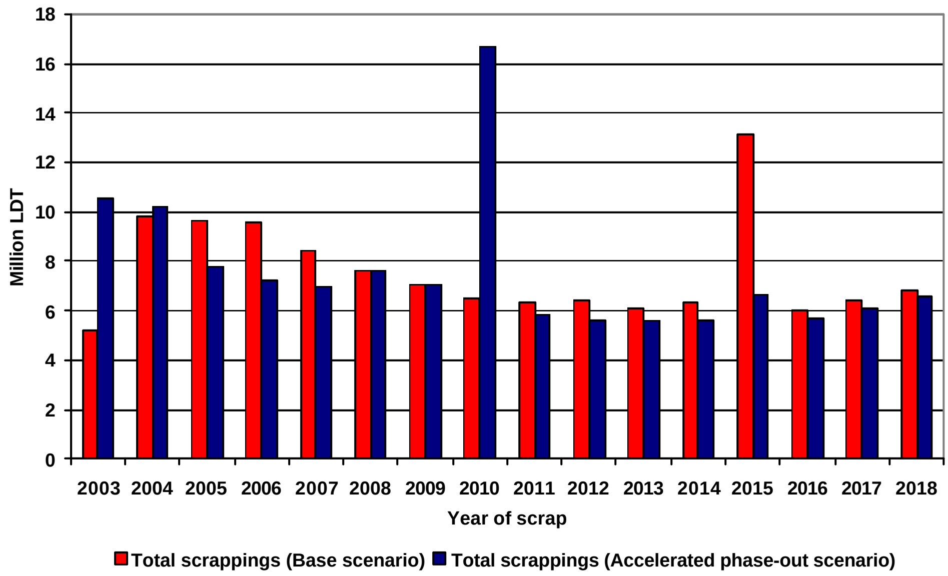


Figure 6.6 Comparison of phase out schemes (million LDT) (All types including single hull oil tankers)

It is clear that accelerated phase out will put additional pressure on the demolition market, both because of higher peak volumes and because of a shorter period to adjust to the additional supply of vessels to the ship scrapping industry.

As argued later, it is unlikely that this will lead to capacity constraints in the industry, but the excess supply will, very likely, affect the scrap prices in a downward direction - to the benefit of the ship scrappers.

The equilibrium price could, in theory, decline below zero, i.e. the ship owners could end up having to pay to have their vessel decommissioned[33]. In such a scenario, waiting times could be observed, as some ship owners could decide to wait until the price obtainable for a vessel for decommissioning increases again.

Following the peak in the excess supply, the ship scrappers will have to adjust to a large drop in the supply of vessels for demolition following the peak in 2010. This will, as pointed out by Greek Shipping Co-operation Committee (2003) lead to "feast and famine" for the ship scrappers. Given the basic nature of the ship scrapping industry it will, however, be relatively easy to adjust to the lower volumes following the peak in 2010.

Other markets, like the market for recycled steel and the newbuilding market, could potentially be affected by the accelerated phase out of single hull oil tankers.

[33] No attempt has been made here to estimate the magnitude of the effect on the scrap prices.

However, given that "recycled steel from ships forms an insignificant share of the total steel production, as well as the global supply of recycled steel" (BIMCO (2001), page 11) it must be assumed that the accelerated phase out of single hull oil tankers will only affect the prices on the market for recycled steel marginally.

There is, however, no doubt that the newbuilding market will be affected (and already has been). The upswing in demand for oil tankers will, as pointed out by the Greek Shipping Co-operation Committee (2003), lead to "feast and famine" for the shipbuilders too. However, as the excess demand for oil tankers might take up the space for other types of vessels, the shipbuilding yards could experience excess demand for these, dampening the "famine"-effect.

6.4 Sensitivity analyses

The projections presented above are based on a number of technical assumptions and delimitations (see Section 6.2.3). The assumptions have been necessary, to make it possible to estimate the future scrapping volumes. The assumptions have been chosen to reflect the future development as well as possible. However, in some cases it is very difficult (debateable) to predict the most likely outcome. In these cases, the assumptions used have been determined to reflect the "worst case" to have an output with a clear cut.

Below, the effect of the key assumptions is addressed to examine the sensitivity of the results of the assumption made. For some of the assumptions the analysis is qualitative rather than quantitative.

Scrapping prior to dates in regulation

In the main analysis, it is assumed that the single hull oil tankers are sold for demolition at the dates specified in the regulation. In reality, market forces and the more strict inspection conditions, including the revised scope of the “Condition Assessment Scheme” and of the “Extended Survey Programme” approved by MEPC 50, will, very likely, imply that some vessels are scrapped prior to this. How the results are affected by taking this factor into account is analysed here.

The effect is analysed on the basis of the estimated average age at phase out date and the historical observed scrapping pattern (see Figure 6.1). For example, the average age at phase out of the vessels due for phase out in year 2015 for the Base scenario (IMO 13G) is close to 24 years. From the analysis of the historical scrapping pattern, it appeared that around 25% of the oil tankers are scrapped prior to this age. Hence, 25% of the vessels which are due for phased out in 2015 can be expected to be scrapped before year 2015. These 25% have in this sensitivity analysis been "reallocated"[34] to the years before, in relation to the share of vessels scrapped at the specific ages. The same considerations have been made for all years and the figures aggregated.

[34] Taking into account the average age at phase out in the main scenarios and the decommissioning frequency function of oil tankers.

The estimated effect is illustrated in the figures below. The fully coloured columns show the estimates of the main analysis, whereas the check pattern show the estimates of future scrappings of oil tankers taking into account that some vessels are scrapped prior to the dates specified in the regulation. Figure 6.7 shows the estimates for the Base scenario and Figure 6.8 the results for the Accelerated phase out scenario. As it can be seen, the estimates for the Accelerated phase out scenario are virtually unchanged by taking this effect into account. The effect is larger for the Base scenario.

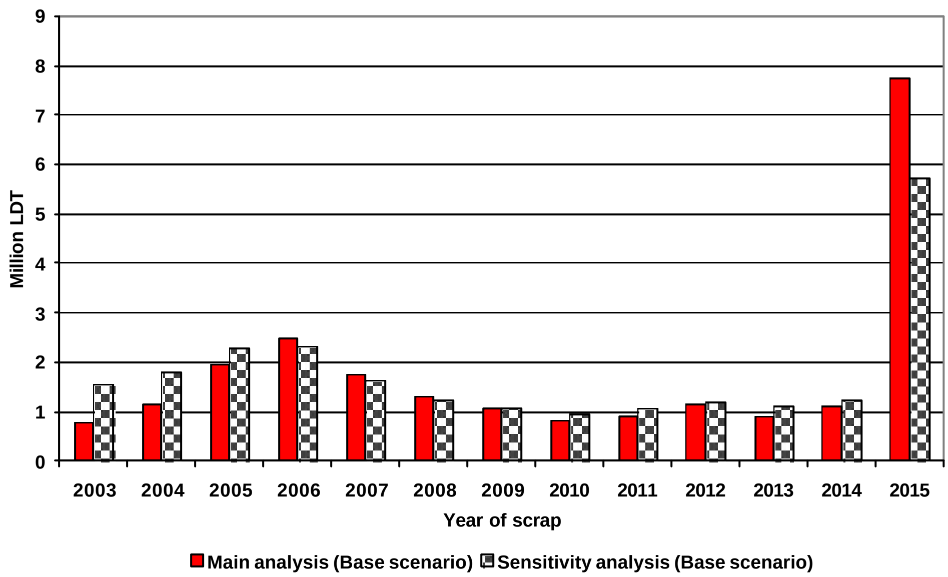


Figure 6.7 Sensitivity analysis: Effect for Base scenario of scrapping prior to dates specified in regulation (single hull oil tankers)

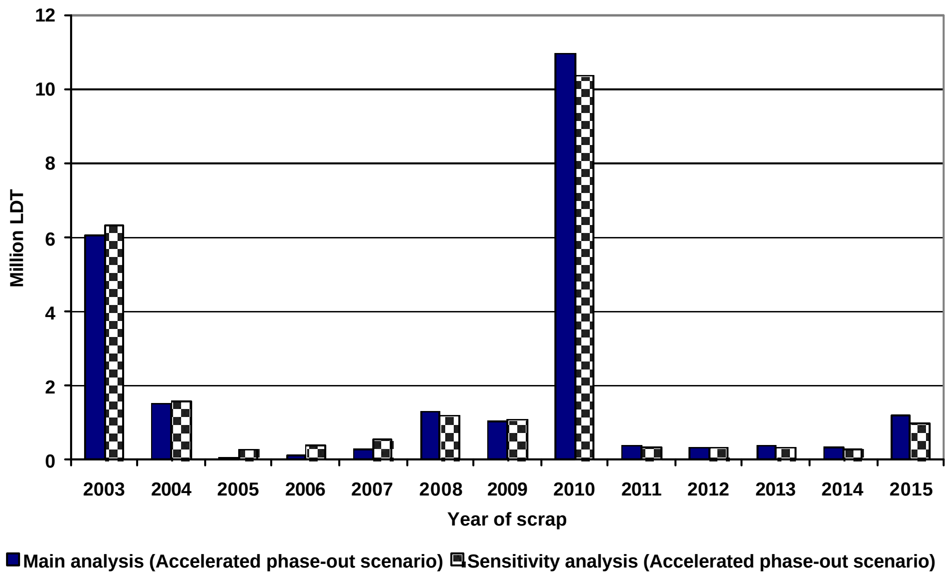


Figure 6.8 Sensitivity analysis: Effect for Accelerated phase out scenario of scrapping prior to dates specified in regulation (single hull oil tankers)

The intuition behind these results is clear. The average age at scrap is lower for the Accelerated phase out scenario compared to the Base scenario. Accordingly, a smaller share of the vessels will be scrapped prior to the phase out dates relevant for the Accelerated phase out scenario.

For example, the average age at phase out is only around 21 years for the vessels phased out in 2010 under Accelerated phase out scenario. As only 6-7% of the oil tankers historically have been scrapped before the age of 21, only few of these vessels can be expected to be scrapped prior to 2010. Contrary, the average age at scrap for the vessels due for phase out in 2015 under the Base scenario is, as mentioned, close to 24 years. Accordingly, a larger share (around 25%) can be expected to be sold for scrap prior to 2015.

Poor/strong freight markets

The market conditions in the freight market do, as mentioned earlier, affect the volume of tonnage supplied to the scrapping industry. Ship owners will keep their vessels in operation for an extended period of time, when the freight markets are strong and scrap their vessels earlier when market conditions are poor.

The historical fluctuations in the level of scrap give an indication of the effect of changing conditions in the freight market. The average yearly level of scrap during 1994-2003 was 4.9 million LDT[35], whereas the maximum and minimum volumes scrapped in a year were 6.4 million LDT and 3.0 million LDT, respec-

[35] After correcting for the figures for 2003 only cover Jan-Sep.

tively. This indicates that the changing market conditions affect the level of scrap by around 30-40% in each direction compared to the average level.

To analyse the consequences of good/poor market conditions in the freight markets for the estimates of the main analysis, it is assumed that a strong freight market lowers the level of scrapping of other types of vessels by 35%, whereas a poor freight market increases the level of scrapping of other types of vessels by 35%. As this is mainly of interest for the peak volumes, only the consequences for these have been analysed here.

Figure 6.9 shows the effect of this on the estimates of the peak volume of 2015 for the Base scenario, whereas Figure 6.10 shows the same for year 2010 for the Accelerated phase out scenario.

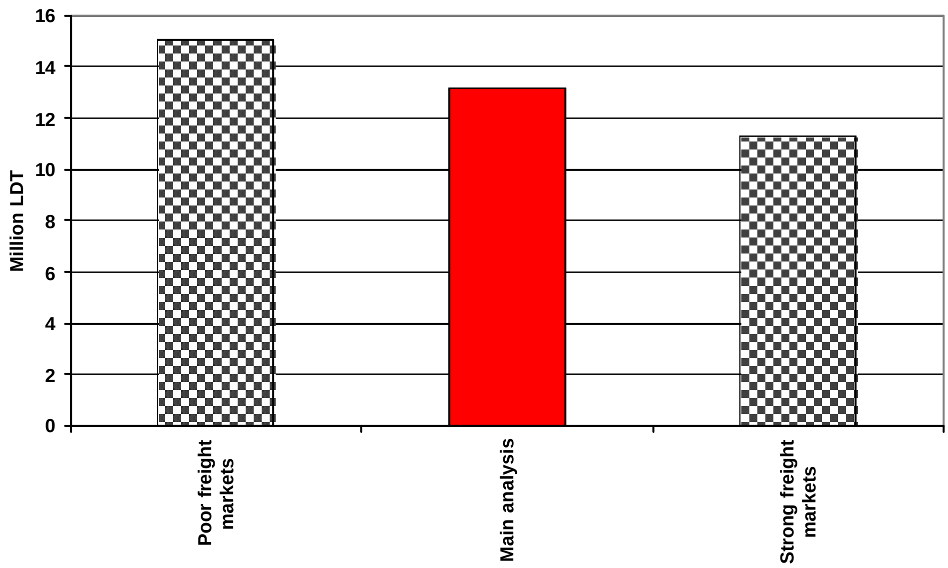


Figure 6.9 Sensitivity analysis: Poor/good market condition, effect of the peak volume of 2015 - Base scenario (All types including single hull oil tankers)

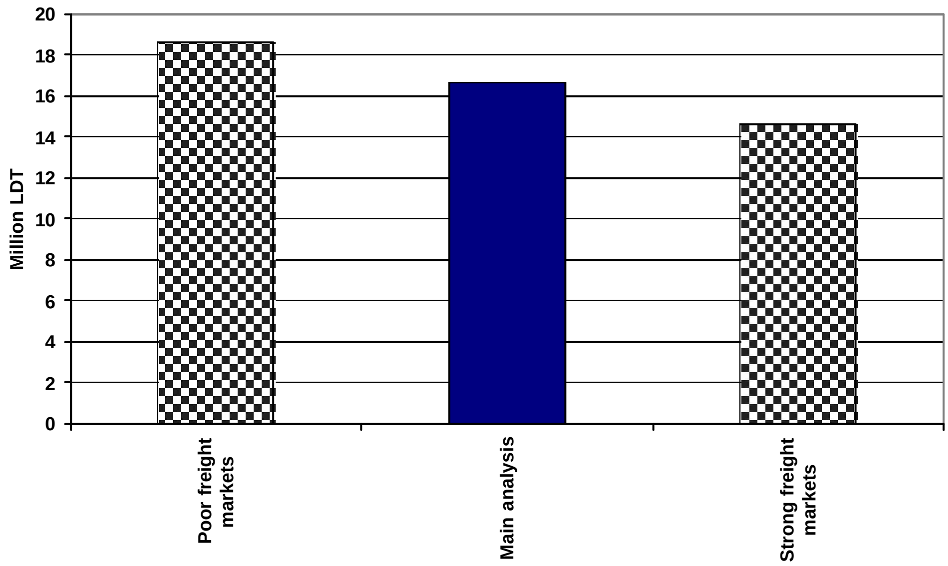


Figure 6.10 Sensitivity analysis: Poor/good market condition, effect of the peak volume of 2010 - Accelerated phase out scenario (All types including single hull oil tankers)

The figures show that the effect of poor/strong market conditions in the freight market is relatively limited, as the scrapping of other types of vessels in the peak years is of relatively little importance compared to the effect of the phase out regulation. However, poor freight markets increase the scrapping volume in the peak with approximately 2 million LDT in both scenarios (and vice versa for a strong freight market).

Reshuffling of other types

In the main analysis, it is assumed that other vessels than single hull oil tankers are scrapped according to the historical life time expectancy and the age profile of the current fleet. However, in reality the ship owners will, most likely, take into account that the ship scrapping market in some years will be flooded with single hull oil tankers, because of the phase out regulation. In these years, the scrapping prices are likely to go down as a consequence of the excess supply making it less attractive to scrap a ship in those years. Hence, the ship owners will have a clear incentive to avoid scrapping in the peak year (2010 for the Accelerated phase out scenario and 2015 for the Base scenario).

Figure 6.11 and Figure 6.12 show the estimated effect of a 50% reshuffling of other types of vessels than single hull oil tankers (25% to the year before the peak year and 25% to the year after). Again, the fully coloured columns show the estimates of the main analysis, whereas the check pattern shows the estimates of the sensitivity analysis.

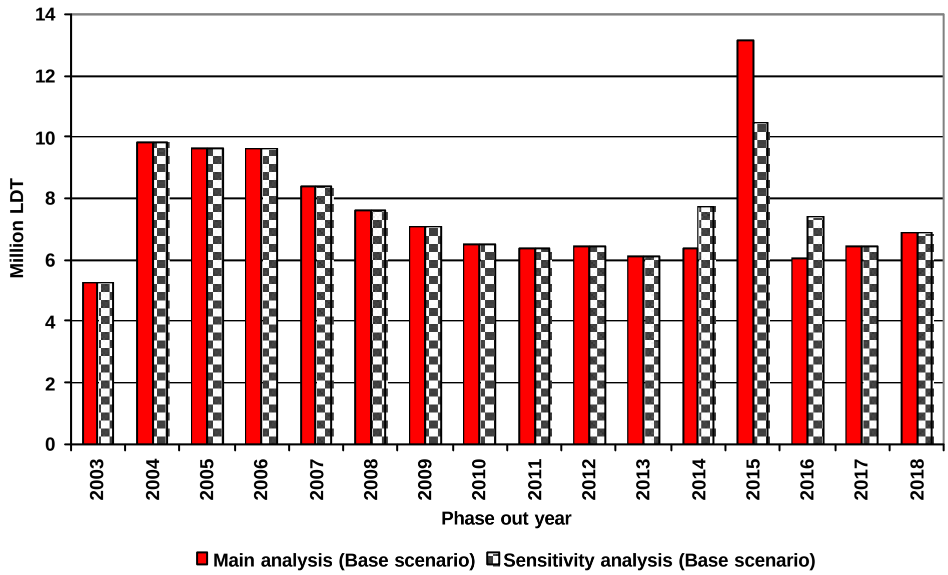


Figure 6.11 Sensitivity analysis: Effect on Base scenario of 50% reshuffling of other vessels (All types, including single hull oil tankers)

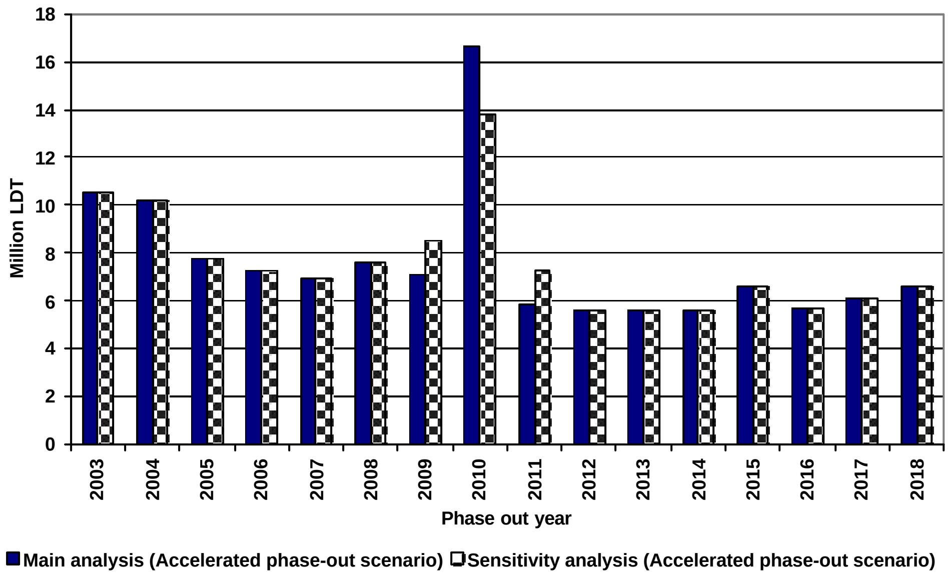


Figure 6.12 Sensitivity analysis: Effect on Accelerated phase out scenario of 50% reshuffling of other vessels (All types, including single hull oil tankers)

The figures show that the projection of the future scrapping peak volumes can be affected significantly if the owners of other types of vessels react to peak volumes of scrapping of single hull oil tankers, by either scrapping their vessels earlier or by postponing the date of scrap.

The magnitude of this effect depends on the anticipated effect on the scrap prices. As the distribution of the scheduled phase out is more uneven for the Accelerated phase out scenario, the effect of reshuffling of other types of vessels is expected to be larger for this scenario compared to the Base scenario.

Interestingly, this implies that owners of others types of vessels in this respect is worse off due to the phase out of single hull tankers, as the ship owners changes the otherwise optimal decision on when to scrap. Even if the owners of other types of vessels do not change the decision on when to scrap, the ship owners will be worse off, because the owners obtain a lower price when selling for scrap.

Vessels used for other purposes
In the main analysis it is assumed that the single hull oil tankers phased out are decommissioned. In reality, possibilities exist for using the single hull tankers for other purposes. For example:

- Single hull tankers can, theoretically, continue trade with non petroleum oil cargoes (e.g. vegetable oils, feedstock, etc)

- Single hull oil tankers can be rebuilt to FPSOs (floating production storage and offloading) or FSOs (floating storage and off loading).

The magnitude of the impact of this on the estimates provided in the main analysis is difficult to assess as this, among other things, depends on the market conditions of these. However, there is no doubt that these possibilities tend to dampen the effect of the regulation on the ship scrapping industry, as the vessels used for other purposes will not be supplied to the ship scrapping industry.

EC regulation not global
As discussed in Section 6.2.3, there are a few differences between the EC regulation and the new IMO regulation adopted in December 2003. In the main scenarios, these differences have been ignored applying the EC regulation on all single hull tankers. The consequence of this simplification is discussed below.

Different dates of entry force and phase out dates in the new IMO and EC
The EC regulation came into force as of October 2003, calling for phase out of some single hull tankers by 2003. The new IMO regulation will only apply from April 2005 and the first phase out year is 2005. This means that the life time of single hulled tankers can be prolonged by not using them for transport in EU. Hence, it can be expected that, in practice, the phase out volume estimated for year 2003 and 2004 in the main Accelerated phase out scenario will be "re-distributed" over years 2003-2005. Accordingly, the main scenario most likely overestimates the implications of the accelerated phase out for years 2003 to 2005.

Bilateral agreements (IMO)
Single hull oil tankers are exempted from calling EU ports in relation to the dates specified in the EC 1726/2003 regulation. The US has a similar set of rules with comparable end dates (the US OPA 90 regulation).

However, the IMO regulation accepts bilateral agreements allowing single hull oil tankers to call the ports of the involved countries. It is not possible to estimate how widespread the use of this will be, but it could have significant impacts on the projections of the future peak volumes. In the main analysis it was assumed that no countries will use the possibility of making these bilateral agreements (as it was assumed that the EC 1726/2003 is globally applicable).

The other extreme is, naturally, to assume that all other countries than EU countries and the US will use these bilateral agreements. The exact effect of this is difficult to assess, but taking a look at the current pattern of oil trade gives a good indication (here distances are ignored). The US and Europe account for slightly more than half of the total volume of the world imports of oil (see Appendix 8 for details). As this figure is approximately equivalent to the share of double hull oil tankers, the total fleet of single hull oil tankers could, in principle, find other trading opportunities if all other countries than EU countries and the US made these bilateral agreements. Accordingly, assuming this extreme the effect on the future volumes of scrap from the accelerated phase out schemes could be negligible!

However, assuming that all other countries will use these bilateral agreements is probably just as unrealistic as assuming that no countries will use them. So the likely scenario is somewhere in between. Accordingly, the main analysis most likely overestimates the implications of the phase out schemes in general and especially in the peak years where the incentive for making bilateral agreements to prolong the life time is greatest.

Special rules
The special rules relating to single hull oil tankers between 600 DWT and 5,000 DWT have not been taken into account, i.e. in the main analysis single hull oil tankers below 5,000 DWT are treated as *other tankers*.

Analysing the full consequences of the special rules for the small single hull oil tankers is very difficult due to the complexity of the issue and the limitations of the data material. According to EC/CESA (2003), the fleet tanker between 600 DWT and 5,000 DWT consists of around 10 million DWT, of which the EU fleet accounts for around 17% (compared to close to 130 million DWT of vessels larger than 5,000 DWT). Accordingly, omitting the impact of the special rules for the small tanker fleet is not considered to have a significant impact on the estimates of the future volumes of scrapping.

Finally, the new EU and IMO regulations provide for a banning of carrying heavy grades of oil in single hull tankers. This banning is of immediate effect for tankers of 5.000 DWT and above. It will apply also to tankers between 600 and 5.000 DWT as of 2008. The banning provision will likely impact shipowners decision on ship breaking, particularly in the case of those vessels dedicated to the carriage of heavy grades of oil. The possible impact of these banning provisions is not examined in the present study.

6.5 Scrapping Capacity

In this section, the existence of possible bottlenecks is discussed, i.e. the projected volumes of scrapping are discussed in relation to the capacity of the ship scrapping industry.

It is very difficult to estimate the maximum yearly scrapping capacity available world-wide, simply because the quantity scrapped is a function of the price of ships to be decommissioned. Historically, there have been no capacity constraints in the industry, which means that it has been the key drivers behind supply and demand for ships for decommissioning that have determined the historical level of scrapping.

6.5.1 Lower bound estimate of capacity

In the study "*Decommissioning and Recycling of Ships and the Capacity of the Recycling Industry*", (BIMCO, 2001) estimates the capacity of the scrapping industry in order to assess if there will be any capacity constraints in the ship scrapping industry in the future (with respect to the "old" IMO 13G). A lower bound of capacity is estimated as the sum of maximum annual scrapping activity per country during 1991-2000. Although, this is not an ideal approach of assessing the capacity of the scrapping industry, we have adopted a similar approach for assessing the lower bound of capacity due to lack of comprehensive and detailed data.

By taking the maximum annual volumes of scrapping per year during 1994-2003 for each country, the lower bound of total annual capacity is estimated to 8.3 million LDT (see Table 6.6). In BIMCO (BIMCO, 2001), the lower bound of the annual capacity is estimated to 7.7 million LDT in 2000. Note, by using this approach it is implicitly assumed that all countries have utilised all their capacity at some year during 1994-2003. Accordingly, this estimate is a very conservative estimate of the lower bound of the capacity of the ship scrapping industry.

Table 6.6 Maximum volume scrapped during 1994-2003 (all types) (million LDT)

Scrap location		**Maximum LDT per year (1994-2003)**
Indian Sub Continent	Bangladesh	1.7
	India	2.9
	Pakistan	0.7
	Indian Sub Cont	0.3
Asia	China	1.9
	Vietnam	0.1
	Other Asia	0.0
Europe	EU	0.0
	Turkey	0.1
Americas	North America	0.0
	South America	0.0
	Mexico	0.1
Other	Other/Unknown	0.0
Total		8.3

Note: 2003 figures have been adjusted to full year

The lower bound figure of 8.3 million LDT should be compared with the estimated peak volume of 16.7 million LDT for the Accelerated phase out scenario and 13.2 million LDT for the Base scenario.

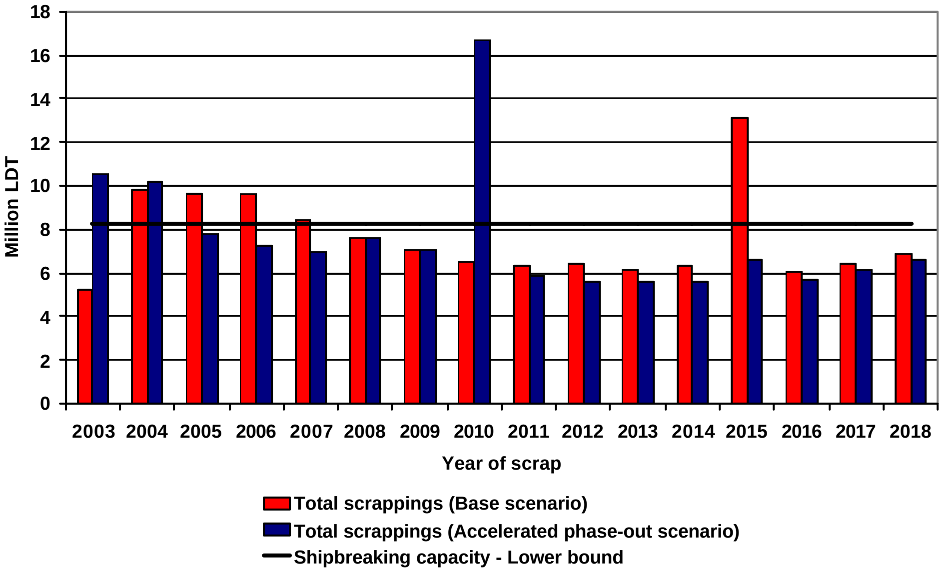


Figure 6.13 Comparison of lower bound estimate of capacity and the projections of future scrapping

Figure 6.13 shows the total projected scrapping in the main Base and Accelerated phase out scenarios and the estimated lower bound of scrapping capacity. The figure shows that the projected scrapping volumes greatly exceed the lower capacity in year 2015 in the Base scenario and in year 2010 in the Accelerated phase out scenario. However, this is not sufficient to conclude that the demand for ship scrapping can not be fulfilled due to capacity constraints.

6.5.2 Upper bound

It is not realistic to assume that all countries have utilised all their *potential* capacity at some year during 1994-2003, and if ship scrappers can increase profits by generating more capacity, they will do so. Accordingly, the real capacity of the ship scrapping industry is, possibly, much higher than the lower bound estimate. It is impossible to estimate the exact upper bound on the basis of hard facts.

However, as the currently applied practice of decommissioning only requires a suitable beach and a sufficient labour force, it seems reasonable to assume that there will be abundant capacity in the future, assuming the current practice of decommissioning ships will also be applied in the future

This view is supported by EU (2000). According to EU (EU, 2000), current locations have no real physical limits on expansion and therefore capacity ultimately depends on how long the beach is and how many workers that can be attracted to work there. EU (2000) states that the only constraint, which might exist in the future, would be local planning and environmental concerns. However, more capacity will not be provided without costs. Recalling the discussions in Chapter 3, the higher the scrapping volume, the lower the price is that the ship scrappers are willing to pay.

As the ship scrapping industry most likely does not *readily* have sufficient capacity to handle the estimated peak volumes, it is not certain that it will be optimal for the industry to adjust to the capacity levels. It might be optimal, only partly, to adjust the capacity, i.e. it could be the case that some of the vessels due for scrap in 2010 will physically be scrapped in 2011 or even 2012. So even though the capacity of the ship scrapping industry is almost infinite, waiting times could be seen around the peak year.

6.6 Overall assessment of impacts

Under normal circumstances, the volume of ship scrapping is determined by market forces. A mandatory phase out scheme for single hull oil tankers interfere with this, affecting in particular the ship scrapping industry, but also the freight markets, the newbuilding market and the economic situation of the ship owners. In principle, the phase out scheme for single hull oil tankers could also affect the market for recycled steel, but the effect here will most likely be marginal, as recycled steel from ships forms an insignificant share of total steel production and the global supply of recycled steel.

The adoption of the EC 1726/2003 regulation and the revised IMO MARPOL 13G implies an accelerated phase out of single hull oil tankers compared to the situation under the IMO MARPOL 13G regulation. This will, naturally, enhance the effects of the phase out.

It is estimated that the impact of the accelerated phase out scheme could lead to a peak volume of scrap in 2010 of up to 16.7 million LDT, which is around 25-30% higher compared to the estimate of the peak volume of 2015 for the IMO MARPOL 13G regulation. Of the estimated 16.7 million LDT the single hull oil tankers is estimated to account for 11.0 million LDT. To put this into perspective, the average yearly level of deliveries of oil tankers has, during the last ten years, been in the region of 2.7 million LDT. Hence, the estimated peak volume of 2010 is equivalent to around four years of oil tanker deliveries.

Several factors are, however, likely to limit the "peak effect" of the accelerated phase out scheme for single hull oil tankers:

- Market forces will, most likely, imply that some single hull oil tankers are scrapped prior to the dates specified in the regulation
- Owners of other types of vessels will have a clear incentive not to scrap in the years where the ship scrapping industry is flooded with single hull oil tankers
- Some of the single hull oil tankers could be used for other purposes and thereby not be supplied to the ship scrappers
- Some countries will, most likely, use the possibility of making bilateral agreements allowing some single hull oil tankers to continue to operate beyond the dates specified in the regulation.

It is not possible to give a robust/precise estimate of the effect of these factors on phase out volumes in the peak years, since the effects are subject to large uncertainties. For example, it is impossible to project how many countries will use the possibility of making bilateral agreements allowing single hull oil tankers to operate beyond the dates specified in the regulation. Furthermore, the actual observed volumes will depend on the future state of the freight markets, which is virtually impossible to forecast. The actual observed peak volumes are also sensitive to how many single hull oil tankers are scrapped prior to the dates specified in the regulation (which is partly related to the state of the freight market).

However, considering the sensitivity analyses of these effects, it is clear that the peak can become much lower than indicated above. It is anticipated that the peak in 2010 due to the EC 1726/2003 and the Revised IMO MARPOL 13G regulation, could become as "low" as 10 million LDT.

Even this "low" estimate is, however, considerably, higher compared to the level of scrapping seen historically. During the last 10 years, scrapping volumes have fluctuated between 3.0 million LDT and 6.4 million LDT.

Accordingly, the accelerated phase out scheme will undoubtedly put pressure on the ship scrapping industry.

Even tough, the capacity of the ship scrapping yards are very likely sufficient to handle the increased volumes, the ship scrapping yards might find it optimal not to adjust to peak volumes. This also because the accelerated phase out scheme will give the ship scrapping industry shorter time to adjust compared to the peak resulting from the IMO 13G regulation. Accordingly, some waiting times might be seen, especially if the price obtainable, when a vessel sold for scrap, goes below or close to zero.

How much the accelerated phase out of single hull oil tankers will affect the prices in the demolition markets is impossible to say, but the excess supply will, keeping other things equal, no doubt put a downward pressure on scrap prices. This will, naturally, benefit the ship scrappers, who will pay less for the ships earning a higher profit from decommissioning the ship.

Contrary, this effect will have a negative impact on the economic situation of the affected ship owners. However, the main adverse effect of the economic situation of ship owners, stems from the shortening of the trading life of their vessels. Around 250 of the single hull oil tankers, which will be phased out in 2010, are less than 20 years of age at the time of phase out compared to an average historical life time of 26.1 years. More than 670 of the vessels phased out in 2010 are below the average historical life time at the time of phase out.

To some (possibly minor) extent, the adverse effect on the economic situation of the owners of the vessels phased out could be offset by the indirect positive effect of the accelerated phase out on the freight rates.

The effect of the accelerated phase out scheme on the freight markets will depend on the speed of the replacement of the vessels phased out. Given the high level of newbuilding of oil tankers, the effect might be limited. Interestingly, the phase out of single hull oil tankers could, however, affect the freight rates in other shipping segments, as the boom in building oil tankers have taken up the berths at the shipyards, limiting the fleet growth in other segments.

Accordingly, the regulation will affect the ships owners unevenly. Ships owners of single hull oil tankers are likely to suffer a severe economic loss, while all other ship owners are likely to increase earnings due to the anticipated second-order effect on the freight markets.

The replacement need will, and has probably already, put an upward pressure on the newbuilding prices - also for other types of vessels than oil tankers as these are build in the same berths.

Given the high number of oil tanker deliveries seen in recent years and the large number of oil tankers on order, it is anticipated that the accelerated phase out will not lead to a shortage of oil tankers.

7 Guidelines on clean ship recycling

7.1 An overview

As described in Chapter 2, a set of interrelated guidelines for ship scrapping has recently been developed in the context of the IMO, the Basel Convention and the ILO respectively.

The IMO Guidelines deal with the requirements before the ship enters the scrapping facility (preparation for scrapping). The Guidelines were adopted by IMO at the 23rd assembly in December 2003.

The Basel Convention Guidelines deal with the requirements regarding dismantling of ships at the scrapping facilities in the destination state and, to a certain extent, with the requirements prior to shipping in the dispatch state. The Guidelines were adopted in December 2002 at the Sixth Meeting of the Conference of the Parties to the Basel Convention (COP 6).

The ILO Guidelines deal with the safety and occupational health aspects throughout the entire process. The guidelines were endorsed at the tripartite meeting in October 2003. The Guidelines were adopted by the General Body at its recent meeting in March 2004.

In addition, a preliminary Industry Code of Practice on Ship Recycling has been prepared in the context of the International Chamber of Shipping by its Industry Working Party on Ship Recycling, IWPSR. Furthermore, some of the ship scrapping states have developed or are currently developing guidelines for ship scrapping.

Each of the guidelines is developed from the view point of the responsible organisation and covers the parts of the scrapping process under that organisations jurisdiction. The set of guidelines cover the full ship life cycle from cradle to grave, as shown in Figure 7.1.

None of the international guidelines mentioned above are legally binding, using of them is voluntary. Because of this, it is the widespread opinion within the stakeholder community that the guidelines will only receive limited use.

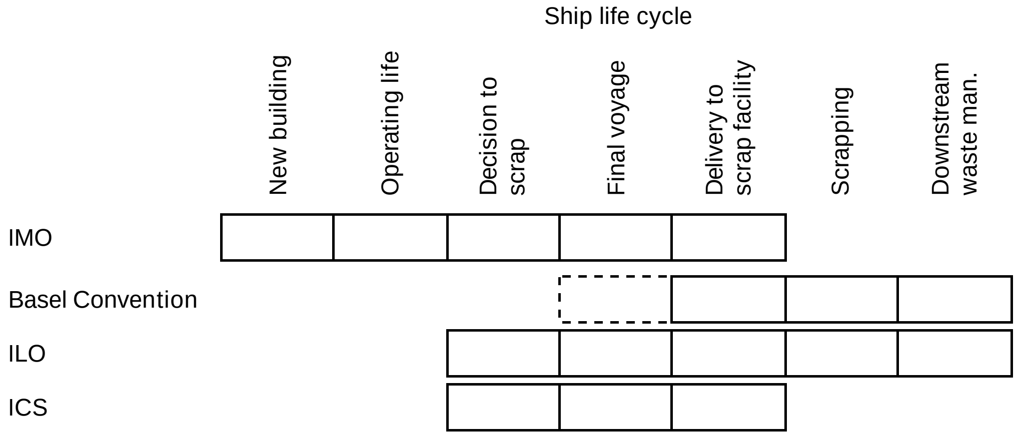


Figure 7.1 Life cycle phases covered by the guidelines. Dashed lines indicate only partiat coverage

There are some overlaps between the guidelines, and each guideline refers to at least one of the other guidelines. This fact has led some of the industry parties, interviewed for the study, to propose the development of one joint set of guidelines. The argument for one joint guideline is that it would ease the overview of the area and close any potential loopholes between the guidelines. One of the first jobs for the IMO, Basel Convention secretariat and ILO tripartite work-group is to develop a single document to guide the industry and other involved parties.

The different guidelines are described in more detail in the sections below. The focus is on the contents of the guidelines, in particular which part of the scrapping process is covered by the respective guidelines and how they interrelate.

7.2 The International Maritime Organisation, IMO

IMO's role in the scrapping of ships was first raised at the 44th Marine Environment Protection Committee (MEPC) session in March 2000. Following this session, a correspondence group was established to research this issue and provide a range of information about current ship recycling practices and suggestions on the role of IMO.

MEPC developed a set of recycling guidelines, "Guidelines on ship recycling", which were finalised at the MEPC 49th session in July 2003. The Guidelines were adopted by IMO at the 23rd assembly in November-December 2003. IMO is at the moment discussing pros and cons on making the guidelines mandatory.

The aim of the IMO Guidelines (IMO 2003) on ship recycling is to provide guidance to flag, port and scrapping states, ship owners and maritime equipment suppliers as to "best practice", which takes into account the ship recycling process throughout the life cycle of the ship. A ship is in the guidelines defined as "a vessel of any type whatsoever operating in the marine environment …and a vessel that has been stripped of equipment or is towed".

The guidelines contain both procedures for existing and new ships. It makes references to the guidelines developed by the Basel Convention, the International Labour Office and the International Chamber of Shipping.

The guidelines include procedures on the identification of hazardous materials. The guideline includes three lists for the identification of hazardous materials. The first is based on the "list of hazardous wastes and substances under the Basel Convention that are relevant to ship dismantling" (Appendix B to the "Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships"). The two others are based on annex 1 and 2 of the "Industry code of practice on ship recycling, August 2001" (described below).

The guideline introduces a "Green Passport", which is a document providing information with regard to materials known to be potentially hazardous utilised in the construction of the ship, its equipment and systems. The continuously updated passport should accompany the ship throughout its operating life.

Finally, the IMO guidelines include procedures for preparation of a ship for recycling. These, among others, include selection of the recycling facility and preparation of a ship recycling plan. Also to be evaluated when selecting a recycling facility is the capacity of the facility to perform recycling in compliance with the guidelines developed by ILO and the Basel Convention.

7.3 The Basel Convention

The Conference of the Parties to the Basel Convention on the control of transboundary movement of hazardous wastes and their disposal, the Basel Convention, decided at their fifth meeting (COP 5) in December 1999 to address the subject of ship dismantling. The background for taking up this subject was recognition of the need for improving the current ship dismantling procedures and further, to manage the increasing volume of vessels to be disposed.

Following COP 5, the Technical Working Group, TWG of the Basel Convention were, instructed to initiate work of the development of Technical Guidelines for the Environmentally Sound Management for Full and Partial Dismantling of Ships. TWG was further instructed to include a list of hazardous wastes and substances under the Basel Convention applicable to ship dismantling. The TWG published their draft guidelines in April 2002 (TWG, 2002). The Guidelines were adopted on COP 6 in December 2002.

The guidelines focus on management of hazardous materials during the ship dismantling process and are aiming at providing guidance to countries, which have or wish to establish facilities for ship dismantling.

The guidelines provide information and recommendations on procedures, processes and practices that must be implemented to attain Environmental Sound Management, ESM, at such facilities. Further, the guidelines provide advice on monitoring and verification on environmental performance. In the context of the Basel Convention ESM means "taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes".

The TWG guidelines are applicable to both existing and new dismantling facilities. The guidelines draw up a concept for a model ship recycling facility, to which existing facilities are to comply after going through a planned process of implementing the principles of EMS. Through this process, eventual gaps between the current practices at the facility and the model facility are identified and closed. The guidelines divide the necessary facility upgrading modifications into three groups depending on the size and complexity of the modification. The simplest modifications should be completed within one year, the more complex within five years and the largest and most complex within ten years. The modifications are subject to variations between facilities. New facilities are expected to comply with the model facility.

The guidelines describe the principles of ESM of ship dismantling and the current dismantling practises in the large breaking countries. Following this, good practice in environmental control procedures at ship dismantling facilities and good practice in design, construction and operation of ship dismantling facilities are described. Included in the first section is a description of potential contaminants onboard a vessel for scrap and precautions to prevent release of these during recycling. Finally, the guidelines include a description of how to achieve ESM, including a description of how to perform the gap analysis for existing facilities aiming at ESM. The latter includes a generic checklist showing a path for upgrading of existing ship scrapping facilities.

A number of critical requirements in relation to allowing upgrade of existing scrapping facilities are included in the guidelines. These requirements include, among others, establishment of a number of physical facilities, i.e. a separate area for paint removal, a storm water discharge facility and a waste water treatment facility. The most critical requirement is, however, the need for establishment of impermeable floors at the entire demolition area. This requirement seems, from an immediate assessment, not compatible with a beaching facility.

7.4 International Labour Office, ILO

At the 279th session of the ILOs Governing Body in November 2000, an agreement was endorsed stating that as a first step ILO should draw up a compendium of best practices adapted to local conditions leading to the preparation of a comprehensive code on occupational safety and health in ship breaking. In February 2001, ILO published the Issues Paper "Worker safety in the ship breaking industries" (ILO, 2001).

Based on this paper and other material, ILO released their Draft guidelines on safety and health in ship breaking, prior to a tripartite meeting of experts with selected Government, Employer and Worker delegates from Bangladesh, China, India, Pakistan and Turkey. The guidelines were endorsed at the tripartite meeting in October 2003 (ILO, 2003) and adopted by the General Body at its recent meeting in March 2004.

The guidelines are directed towards ship breakers and competent authorities alike and are aiming to assist in the implementation of the relevant provisions of ILO standards, codes of practice and guidelines on occupational safety and health and working conditions.

The objectives of the guidelines are to contribute to the protection of ship breaking workers from workplace hazards and to the elimination of work-related injuries, ill health, diseases, incidents and deaths. Further, they are to assist and facilitate the improved management of occupational safety and health issues in or about the workplace.

The guidelines are divided in two parts. Part one describes the national framework. Part two describes the safe ship scrapping operations.

Part one includes, among others, a description of the general responsibilities, duties and rights. It also includes descriptions of occupational health and safety management and systems for reporting, recording and notification of work-related injuries and diseases, ill health and incidents. The guidelines prescribe implementation of an occupational health and safety management system to ensure a systematic approach to improving the working conditions at a ship breaking facility. The design and application of the system should be guided by the ILO guidelines on occupational health and safety management systems.

Part two of the guidelines describe systems for planning of a safe operation during the dismantling of a ship. This includes, among others, development of safe ship dismantling plans and schedules, and performance of hazard identifications and risk assessments. The greater part of part two is a description of preventive and protective measures towards a large number of hazards.

The guidelines include the list of hazardous wastes and substances under the Basel Convention that are on board or inherent in the ship's structure when the vessel arrives at a dismantling site (Appendix B of the Basel Conventions Technical Guidelines for the Environmentally Sound Management for Full and Partial Dismantling of Ships).

7.5 International Chamber of Shipping, ICS

In February 1999, the Industry Working Party on Ship Recycling, IWPSR was established under the co-ordination of the International Chamber of Shipping, ICS. The Working Party was established in response to the growing public concerns on environment and safety issues related to ship scrapping.

IWPSR published their preliminary Industry Code of Practice on Ship Recycling, ICPSR in August 2001 (Marisec, 2001).

The focus of the ICPSR is on issues related to preparation of the ship for recycling, which, according to IWPSR, is what ship owners themselves can reasonably be expected to address (Marisec, 2001). The main focus of the ICPSR is on hazardous materials onboard the ship and the registration and minimisation of the presence of these before delivery for recycling.

The ICPSR has no statutory effects towards ship owners, but the industry organisations involved in the development of the code are committed to encourage the widespread use of it within the industry.

ICPSR includes a list of issues in relation to securing promotion of safe and environmental friendly ship recycling, which the industry organisations are committed to promote towards relevant parties within the shipping industry and ship scrapping industry. An example is the urge for use of a standard ship recycling contract, such as the Demolishcon developed by the Baltic and International Maritime Council, BIMCO.

Of the more tangible contents of ICPSR is an inventory of potentially hazardous materials on board a ship, consisting of two lists, which have later been included in the IMO guidelines. This inventory can be used for registration of hazardous materials before handing over a ship to the scrapping yard. The inventory is divided in three. Part one includes potentially dangerous materials in the ship's structure and equipment, part two includes potential hazardous materials in operationally generated wastes and part three includes hazardous materials potentially present in store rooms.

7.6 National regulation

A few nations have developed or are working on developing specific guidelines describing procedures for scrapping of ships within their country. Other nations refer to national regulations and/or recommendations covering the ship scrapping industry including, among others, issues related to environment, health and safety concerns.

Below is presented the identified national guidelines. The description of standards and practices for the three ship scrapping nations, India, China and Bangladesh, is mainly based on an ILO study from 2001 (ILO, 2001), supplemented with information obtained through this project. Several inquiries to national authorities, ship scrapping organisations etc. have been made, to get a full update on existing standards and practices, but without result. A more in depth investigation of the subject is outside the scope of this study.

7.6.1 United States of America

The United States Environmental Protection Agency, US EPA has developed a set of guidelines for ship scrapping in the United States. The guidelines, 'A Guide for Ship Scrappers: Tips for Regulatory Compliance' were issued in the summer of 2000 (US EPA, 2000).

The guidelines are a compliance assistance tool, intended to provide site supervisors at ship scrapping facilities with an overview of the most pertinent environmental and workers health and safety requirements to assist them in ensuring compliance at their facility.

The guide is structured by specific processes that occur in ship scrapping operations, e.g. asbestos removal, metal cutting, fuel and oil removal. For each described process references are made of where to find the requirements in the Code of Federal Regulations.

7.6.2 India

The Central Pollution Control Board in Delhi has prepared environmental guidelines for ship scrapping industries aiming to minimize the effect of the industries on the surrounding environment through proper siting of industries and by preparing and implementing an environmental management plan and a disaster management plan. The guidelines include a description of the appropriate pollution control measures regarding solid waste, air pollution, water pollution and noise. It also includes aspects of workers' safety.

31st August 2000, the Gujarat Maritime Board, GMB, introduced new regulations covering safety measures for the beaching of vessels. Substance of the regulation was documentation of a gas-free certificate before beaching and a permission to start the cutting operations to be issued by GMB following the removal of hazardous materials from the vessel. The Alang ship scrapping industry responded by calling an indefinite strike, which lead to the postponement of the regulation. The gas-free certificate was introduced in 2001.

In October 2003, Indian Supreme Court ordered the state pollution control board to ensure that ships to be broken-up in India should be properly decontaminated by the ship owner before scrapping. In December 2003, the Gujarat Pollution Control Board issued a closure notice to a ship breaking yard for not following the regulations on control of solid waste and hazardous chemicals (Business Standard, 2003).

7.6.3 China

The State Environmental Protection Agency (SEPA) issued a report in December 1999 on Environmental protection in dismantling of imported scrap-ships in China. The report confirmed that most of the vessels worldwide are still beached, but it also stated that: "On the basis of ship breaking, we shall create other demolition methods and techniques with Chinese features. So the ship breaking industry will have a bright future in China". The report includes concerns regarding the environmental impact of the process.

The Chinese National Environmental Protection Bureau has published a technical manual on preventing pollution from ship demolition.

SEPA has initiated work on registration of the Chinese ship scrapping facilities with the objectives to rank these according to their environmental status. The ranking will, reportedly, be linked to ship scrapping licences. Furthermore, SEPA is to be setting up a school on ship scrapping (Blankestijn, 2004).

7.6.4 Bangladesh

A national regulatory framework for managing ship scrapping seems to be established. This includes an approval procedure for the site operator under the responsibility of the Ministry of Commerce and Industry, issuing of a “berthing certificate” for each individual vessel to be scrapped and issuing of a “hot work” certificate.

Further, there is a provision under the Environmental Law of 1997 requiring that each and every industry including that of ship breaking must have an environmental clearance certificate from the Department of the Environment, Ministry of Forest and Environment. To achieve this, the ship breaking site must establish an environmental management plan. The Environmental Law is also supposed to cover safety measures, occupational health, waste management, monitoring programmes and disaster management.

Work is ongoing for development of guidelines for ship scrapping in Bangladesh (Ahmed, 2003).

7.7 Sum-up

Characteristics of the described international guidelines are summarised below in Table 7.1.

Table 7.1 Ship recycling guidelines. Part of the recycling process and recycling issues with main focus

Organisation	Guideline	Primary focus recycling process	 recycling issues
International Maritime Organisation, IMO	Guidelines on Ship Recycling	The full ship life cycle until delivery to recycling facility	Registration and minimisation of the presence of hazardous materials onboard the ship. Evaluation and selection of recycling facility
Basel Convention	Technical Guidelines on Environmentally Sound Management for Full and Partial Dismantling of Ships	Ship dismantling - from delivery of ship to recycling facility	Facility lay-out and procedures for ensuring environmental sound management of hazardous materials
International Labour Organisation, ILO	Guidelines on Safety and Health in Ship breaking	Ship dismantling - from decision to scrap the ship	Protection of the health and safety of workers involved in the ship breaking operations
International Chamber of Shipping, ICS	Industry Code of Practice on Ship Recycling	Preparation for recycling - from decision to scrap until delivery to recycling facility	Registration and minimisation of the presence of hazardous materials onboard the ship

8 Green recycling capacity

8.1 Introduction

During recent years, legislators, industry, international agencies and donors, NGO's etc. have increased their focus on the environmental and health problems in the ship breaking industry. This has resulted in initiation of projects and initiatives for development of facilities for green ship recycling, in addition to the recently developed international guidelines for clean ship recycling.

For the present study, the world market for green ship recycling has been scanned to identify green ship recycling facilities. Both facilities which have already performed green recycling of ships, and proposed facilities which could relatively easy offer green ship recycling in the future, have been identified.

The locations of the identified existing and proposed green recycling facilities are shown in Figure 8.1 together with existing beaching sites. The existing facilities are described in Section 8.5 and the identified new projects and initiatives are described in Sections 8.6 and 8.7.

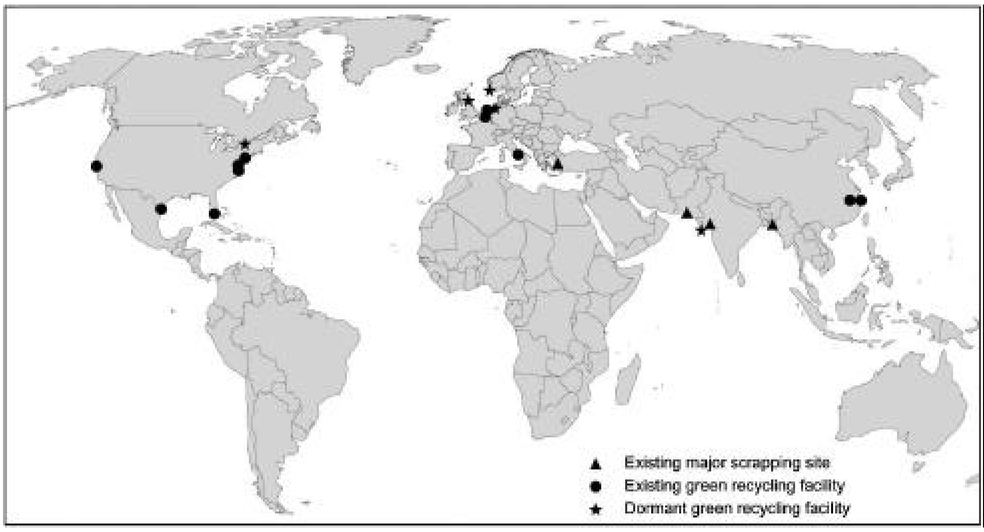


Figure 8.1 Location of existing beaching sites and the identified existing and proposed green ship recycling facilities

8.2 Methodology

The identification of the green recycling facilities has been based on internet searches, review of relevant literature and interviews with key players within the shipping business.

The descriptions of the facilities are thus based on information from homepages, material supplied by the facility and interviews with facility representatives. The information is, where possible, cross-checked. The descriptions of the facilities are highly dependent on the extent and quality of the information received. Scrapping licenses for the facilities have not been checked.

The information searches have been concentrated on facilities capable of handling vessels of around Panamax size and above. For some facilities, the capacity on weight basis could not bee found, but instead a dimension basis. The lower bound for these facilities has been set to a length of 150 m.

8.3 Basis for green recycling of ships

Most of the ship scrapping today takes place in developing countries where labour costs are low. From Table 5.2 it is seen that the four countries India, Bangladesh, China and Pakistan account for 87 % of the total number of ships scrapped in the period 1994-2003 (90 % of the total tonnage scrapped).

An indication of the size of the ship scrapping industry for a given country is the number of companies engaged in the industry. Table 8.1 shows the total number of facilities involved in ship scrapping in different countries according to Lloyds register (Lloyds, 2004). The register includes several types of companies involved in the ship scrapping business, e.g. ship scrappers, ship brokers and scrap dealers. The actual business of individual companies is not evaluated.

Table 8.1 Total number of companies involved in ship scrapping in different countries according to Lloyds register (Lloyds, 2004). Countries with more than ten companies are shown in bold.

Bangladesh (50)	Belgium (3)	Brazil (3)
Canada (1)	**China (14)**	Denmark (5)
Egypt (8)	Estonia (1)	France (3)
Germany (2)	Greece (2)	Iceland (1)
India (249)	Italy (5)	Japan (3)
South Korea (1)	Lithuania (1)	Mexico (1)
Namibia (2)	Netherlands (2)	Norway (1)
Pakistan (27)	Peru (2)	Philippines (1)
Portugal (3)	Singapore (3)	South Africa (1)
Spain (14)	Taiwan (7)	Thailand (1)
Turkey (20)	United Kingdom (9)	United States (3)
Uruguay (1)	**Vietnam (13)**	

The ship scrapping activities in the major ship scrapping nations are often performed under criticisable environmental, health and safety conditions resulting in pollution of the surroundings and dangerous working environment for the workers at the ship scrapping facilities. These effects are described and documented in several studies, for instance (ILO, 2001; Norwegian Ministry of Environment, 1999).

8.4 Definition of green recycling

Some scrapping facilities, driven by legislation or other market forces, perform ship scrapping in a sound way in relation to the environment and workers health and safety, here named "green recycling".

Green recycling is ideally defined as scrapping performed in full accordance with the recycling guidelines as described in Chapter 7. This includes environment, health and safety considerations in all processes from the preparation of a vessel for scrapping, through to the dismantling process itself and in the following management of products, including hazardous waste generated from the dismantling process. It has been proposed to IMO, Basel Convention secretariat and ILO in their tripartite workgroup to develop a single document to guide the industry and other involved parties. A final definition to how to perform "green recycling" awaits the outcome of the working group. However, some of the requirements in the existing guidelines will impose strict limitations as to the possibilities of using existing facilities. E.g. fulfilment of the Basel Convention recycling guidelines requires impermeable floor in the dismantling area, which rules out upgrade of the beach breaking activities.

For the purpose of this study, it has not been possible to evaluate the dismantling procedures for specific facilities for compliance with the recycling guidelines. Instead, the evaluation is based on the facilities' own statements. The facilities identified are thus those promoting themselves as performing ship recycling in a sound way in relation to the environment and workers health and safety. Such promotion includes certification of the facility according to international acknowledged management standards on quality, environment and/or working environment, as for instance ISO 9001, EMAS, ISO 14001 and OHSAS 18001.

8.5 Active green recycling facilities

Table 8.2 summarises the identified active green facilities including their recycling capacities. The capacities are on a general basis believed to be optimistic. Several of the facilities thus currently operate well below their capacity and enlargement of the recycling volume to the capacity would require a considerable enlargement of the workforce etc. Further, the listed capacities for the two Chinese facilities are the facilities' total capacities for traditional breaking and these capacities have not been proven according to the green recycling procedures.

Table 8.2 Identified facilities which have performed green recycling

Country	Facility	Annual recycling capacity LDT
Italy	Simont S.p.a.	80,000
Belgium	Van Heygen Recycling S.A.	120,000
Holland	Scheepssloperij Nederland B.V.	30,000
China	China National Ship breaking Corporation Jiangyin Changjiang Xiagang Ship breaking Company	300,000 *
China	Shanghai Xinhua Iron & Steel Co.	250,000 *
USA	Locations of facilities: San Francisco, California Norfolk, Virginia Baltimore, Maryland Brownsville, Texas Chesapeake, Virginia Port Everglade, Florida	N/A **
Total		780,000

*: The total capacity - has not been proven for green recycling

**: Eight yards have recycled ships for the US MARAD. There are indications that the yards are not open to foreign vessels

8.5.1 Simont S.p.a., Italy

Simont S.p.a. is situated in the Port of Naples. It is a privately owned stock company that has operated in the demolition business for a number of years. The present company structure was formed in 1995.

Dismantling capacity and experience
Simont was founded to dismantle five Italian naval vessels and has demolished some 40 vessels in all.

The company performs pier braking and operates on a lease basis where the required quay and dock facilities are rented from the Port of Naples. Most of the company's heavy equipment is also rented. On a need basis employees are hired from a pool of regularly associated labour force.

The capacity of Simont is governed by the length of the quay lease, the size of the dock and the depth of the harbour. The default capacity is up to 220 m and 8 m draught. If necessary, additional quay length can be leased and breaking up of the keel part can be performed in a larger dock in the harbour (330 m).

The annual recycling capacity of Simont is 70,000 - 80,000 LDT with a present turnover of around 30,000 LDT/year (Danish EPA, 2003).

HSE management
Simont operates by contractors on all major waste disposal issues. The contractors are often those already authorised and used by the port authorities. The company requires authorisation/certificates from its waste management contractors (Danish EPA, 2003).

Since the quay and pier areas are rented, the "yard" is completely tidied up after each demolition and no permanent equipment is left at site once the lease expires. All waste and recycled material is either containerised or moved by truck after finalisation of a ship demolition.

The regulatory approval of demolition is for each specific vessel and based on a vessel specific manual of procedures that requires all activities, incl. hazardous waste management to be completed by the finalisation of the demolition. Gas free certificates are required and issued by the Port Chemical Officer before commencement of work. A safety and risk assessment is part of the approval procedure of the local authorities (Danish EPA, 2003).

Hazardous waste is stored in containers and drums, which are supplied by contractors. No sandblasting is allowed in the Port of Naples and paint is left on the steel plates and consequently disposed of via the steel mills.

8.5.2 Van Heyghen Recycling S.A., Belgium

Van Heyghen Recycling S.A. (VHR) is located at the canal Gent-Terneuzen at Gent, Belgium.

Dismantling capacity and experience
VHR performs pier breaking. The ships are normally dismantled to around one meter above water level, when they are towed on to a concrete slipway. The maximum weight to be towed on to the slipway is 5,000 tonnes. The length of the slipway is 210 m.

The maximum dimension of ships to be received for recycling at the facility is around 260 m in length, 34 m in width and a draft of 12 m.

VHR has in the past broken up ships and platforms with a length of up to 250 m. At present mostly fishing vessels and small coasters are broken up at the facility.

The present annual capacity is around 2,000 tonnes steel. The number of ships dismantled lies around 80 - 100 per year (Van Heygen Recycling, 2004). The facility informs that it has the necessary permits and licenses to dismantle ships 24 hours a day, wherefore it expects the annual capacity could be raised to 120,000 tonnes of steel if the need arises (Wyntin, 2004).

HSE management
VHR informs that it possesses all Belgian legal licences to dismantle and scrap ships according to European regulation and Basel conventions.

Prior to making an offer for scrapping of a ship a VHR representative inspects the ship and draws up a list of waste on board the ship. In case of suspicion of asbestos being present in insulation materials, samples are taken for analysis (Van Heygen Recycling, 2004A). Any scrapping contract includes the list of waste products onboard the ship. On arrival at the facility, the ship is checked according to the conditions of the contract.

VHR pre-cleans the ship before the dismantling work is initiated. Oil, including bunker and bilge water is separated for the waste oil industry. The rest of the waste is incinerated. Waste handling is performed by sub-contractors.

The 0.4 m thick concrete slipway is equipped with a gutter including sedimentation tank and oil separator. An oil-boom prevents oil spilled on the slipway from entering the canal (Van Haygen Recycling, 2004A).

8.5.3 Scheepssloperij Nederland B.V., Holland

Scheepssloperij Nederland B.V. (SN) is located in the city of Gravendeel at the Dordtsche Kil channel. The company was established in 1990.

Dismantling capacity and experience
SN performs slipway breaking on a concrete slipway of 140 m length and 19 m width. The maximum dimensions of ships to be received for recycling at the facility is around 160 m in length, 10 m in width and 10 m in height. The maximum draft is around 5 - 6 m. At present, the company are dismantling two frigates from the Dutch army, but mostly small coasters are broken up at the facility (Boot, 2004).

The company co-operates with a large international salvage company on scrapping of salvaged ships/wrecks. SN has, in several cases, performed scrapping in temporary locations away from Gravendeel. In 2003, the company scrapped the 190 m long and 32 m wide car carrier Tricolor, which sunk in the English

Channel North of Dunkirk. The Tricolor was cut into nine pieces during the salvage operation and transported to Zeebrugge, Belgium where it was scrapped by SN on a site rented for this specific job.

The present scrapping capacity, at the facility at Gravendeel, is around 30,000 LDT a year (Boot, 2004).

HSE management
According to the company they are the only active Dutch company licensed to do ship scrapping.

All wastes are handled by sub-contractors. Asbestos removal is performed by an independent specialist company.

Cutting of ships are performed on the concrete slipway over a ditch connected to an oil-water separator. The slipway is equipped with an oil boom to prevent oil from entering the channel (Boot, 2004).

8.5.4 China National Ship breaking Corporation Jiangyin Changjiang Xiagang Ship breaking Company, China

China National Ship breaking Corporation Jiangyin Changjiang Xiagang Ship breaking Company (Jiangyin yard) is located at the south bank of the Yangzi River about 150 nautical miles from Shanghai. The yard was established in October 1998 and is privately owned.

The Jiangyin yard was in 1999 chosen as the primary shipyard partner by the Dutch shipping company P&O Nedlloyd for their ship recycling project "Shiprecycling" aiming at the development of an environmental friendly ship recycling process. The official start of the co-operation between the Jiangyin yard and P&O Nedlloyd was in 1999 when a Letter of Intent was signed by the two parties.

Dismantling capacity and experience
During the recycling project, P&O Nedlloyd developed a set of procedures and instructions describing the different stages of the recycling process. These procedures and instructions are compiled in a Standard Operating Procedures manual (P&O Nedlloyd, 2003).

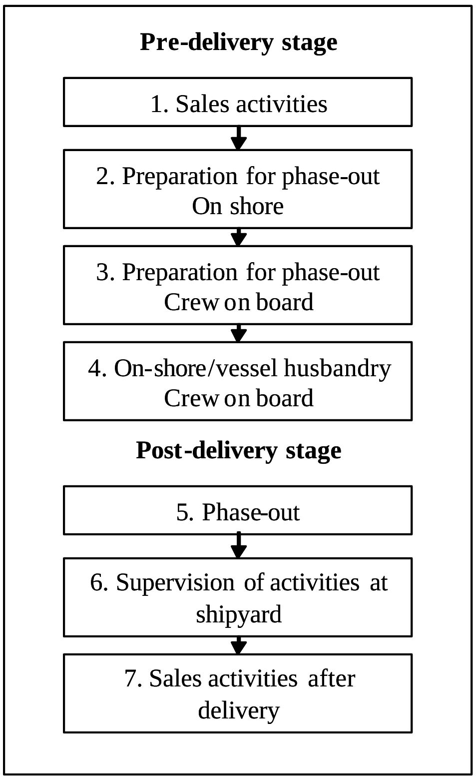
The present working area of the yard is about 500,000 square metres. The annual "non-eco-friendly" breaking capacity is 300,000 LDT. It is not known if the capacity has been altered after introduction of the new recycling procedures. The yard has plans for increasing the total capacity to 500,000 LDT/year (P&O Nedlloyd, 2003).

The Jiangyin yard has, in the period from September 2000 to February 2003, recycled 17 P&O Nedlloyd ships of 10,000 - 25,000 LDT totalling around 310,000 LDT. According to P&O Nedlloyd, the scrapping was performed in accordance with the developed recycling procedures and instructions (Blankestijn, 2004).

The P&O Nedlloyd Standard Operating Procedures manual is proprietary information belonging to P&O Nedlloyd and can thus not be used by other ship owners. The Jiangyin yard is, however, free to perform green ship recycling for other ship owners in accordance with the developed technical recycling procedures.

HSE management
Recycling of the P&O Nedlloyd ships was carried out under supervision of P&O Nedlloyd employees. During the final journey to the facility, work was done onboard the vessel to facilitate the recycling procedure. This work included reduction of oil stocks and surveying for asbestos, radioactivity etc. On delivery of the vessel to the facility the contents of hazardous materials onboard was registered. The vessels were scrapped by sections following pre-cleaning of that section.

The general overview of the recycling procedures is depictured as follows (P&O Nedlloyd, 2003):



For each of the above activities a number of procedures have been developed, detailing contents and responsibilities for the individual sub-activities.

8.5.5 Shanghai Xinhua Iron & Steel Co., Ltd., China

Shanghai Xinhua Iron & Steel Co. Ltd. (Xinhua yard) is located at Choming Island, Shanghai in China and is owned by a joint venture. The company was established in April 1993 and is the only enterprise pursuing ship demolition in Shanghai.

The main market scope of the company is the demolition of waste, ships, cars, imported scrap, cable, electrical appliances and various mechanical and electrical equipments.

The Xinhua yard was chosen as the second shipyard partner by the Dutch shipping company P&O Nedlloyd for their ship recycling project "Ship-recycling". The official start of the co-operation between the Xinhua yard and P&O Nedlloyd was in 2002 when a Letter of Intent was signed by the two parties.

The Xinhua yard was included in the P&O Nedlloyd ship recycling project to test if the recycling procedures developed for the Jiangyin yard could be successfully transferred to a different ship scrapping yard (Blankestijn, 2004).

Dismantling capacity and experience
The Xinhua yard has, from December 2002 to February 2003, recycled two P&O Nedlloyd ships, one weighing 13,250 LDT. The weight of the other ship is unknown.

The company covers 210,000 square meters and has an estimated ship breaking capacity of 250,000 LDT per annum (Blankestijn, 2004). This capacity is not proven according to the new recycling procedures.

HSE management
According to P&O Nedlloyd, scrapping of the two ships was performed successfully in accordance with the developed recycling procedures and instructions developed at the Jiangyin yard.

8.5.6 Recycling facilities used by MARAD, United States

The US green recycling facilities have each recycled one or more obsolete U.S. Navy vessels from the US National Defence Reserve Fleet.

MARAD is responsible for scrapping of the around 200 obsolete US Navy vessels and is acting under a statutory deadline September 30, 2006 for the disposal of these vessels (MARAD, 2003).

The indications are that these facilities are not open to foreign vessels.

8.6 Recycling facilities under establishment

Three green recycling projects were identified with most of the needed infrastructure and permits in place for performing green ship recycling. These projects could possibly be operational within a limited time period.

8.6.1 S.T.O.P. Eemshaven, Netherlands

Stichting Tanker Ontmanteling Platforms (S.T.O.P.) - Tanker and Platforms Dismantling Foundation - was set up in November 2002 by a group of private and public companies, including P&O Nedlloyd, AVR, Royal BAM Group, Royal Niestern Sander, Isotechniek and Steenhuis Recycling. Meanwhile, the group of participants has extended with Wagenborg Shipping, a shipping company located in Delfzijl (in the North of the Netherlands).

The aim of the foundation is to set up a commercial operating green recycling facility/organisation named NV Ecodock where tankers, other sea-going vessels and offshore platforms can be dismantled and recycled. The port of Eemshaven in the north of the Netherlands was chosen as location for the facility.

S.T.O.P. has carried out a feasibility study for the recycling facility. The feasibility study includes establishment of a dry dock and other facilities and infrastructure at the Eemshaven port. Based on the study, a business plan has been drawn up and approved. According to the business plan, the recycling facility at Eemshaven can be operational in the second half of 2006.

The main market focus for the facility will be:
- Ships of up to 20,000 LDT (Panamax)
- Oil platforms in the North Sea
- Problem ships (like the Sandrien).

The capacity for the Eemshaven facility is planned to be up to 200,000 LDT per year. The facility is planned driven on a "lease" basis with the facility being leased to the ship owner. S.T.O.P. will function as broker for the steel sale (S.T.O.P., 2004). It is anticipated that the steel can be exported to other parts of the world by bulk carriers (Blankestijn, 2004).

The planned technical method of scrapping ships at S.T.O.P. is new (S.T.O.P., 2004). Based on the experiences gained from the Eemshaven facility, S.T.O.P. is looking for exporting of similar facilities worldwide.

8.6.2 Able UK, TERRC, United Kingdom

The Able UK Teesside Environmental Recycling and Reclamation Centre (TERRC) facility is located by the Seaton Channel close to the mouth of the River Tees. The facility is an old shipbuilding yard which has also been used for construction and decommissioning of marine structures including offshore oil and gas platforms and jackets.

The present owner, Able UK Ltd, purchased the yard in 1997.

Dismantling capacity and experience

TERRC is licensed as a metal recycling site. It is equipped with a large semi-dry dock facility of around 25 acres, which, according to Able UK, can accommodate ships up to a length of 366 m with no limit on width or up to 15 ships of 200 m length and 24 m width at one time. Maximum draft of ships that can be received is 12.5 m (Able UK, 2004). The estimated ship recycling capacity of TERRC is around 150,000 LDT/year (Marshall, 2004).

Recycling of marine structures has taken place at TERRC since 1996, but no ships has up to now been recycled. In July 2003, Able UK Ltd was awarded a contract by the United States Government's Maritime Administration (MARAD) for dismantling of 13 redundant merchant vessels from the US National Defence Reserve Fleet. The first four of the MARAD vessels have been delivered to TERRC, but dismantling has not been initiated, as a case was raised whether Able UK Ltd had the necessary permissions to dismantle the ships at TERRC. In December 2003, the UK High Court declared that Able UK did not have the necessary permits. The case has been very much exposed in the media and is described in detail below.

HSE management
According to Able UK, ship recycling at TERRC will comply with all recommendations of the IMO Recommendations dated 17th July 2003 for the Ship Recycling Industry (ABLE UK, 2004).

In conjunction with TERRC, the Able Group has developed the landfill Seaton Meadows, with a capacity of circa 7,000,000 tonnes.

Case on lack of necessary permits
In the summer of 2003, Able UK Ltd won a contract for the dismantling of 13 redundant United States naval auxiliary vessels. The contract was awarded by the US Maritime Administration (MARAD), the statutory body in the US responsible for the decommissioning of obsolete vessels in the US National Defence Reserve Fleet. Shortly after announcement of the contract, it was, from several sides, disputed if Able UK had the necessary permissions for performing the ship recycling at the facility and none of the ships has to date been recycled at the facility.

Prior to shipping the vessels from US to the Able facility, the UK Environment Agency had to give their consent under the Waste Shipments Regulation. The notification was considered by the Environment Agency on the basis that all 13 ships would be transferred to the Able facilities and that, following the placement of the 13 ships in the dock, a bund/cofferdam would then be constructed and the dock pumped dry so that the scrap metal could be recovered from the ships in dry dock conditions. The Agency consented to the shipments on 22nd of July 2003 (Environment Food and Rural Affairs Committee, 2003).

On the 30th July 2003, Able UK Ltd submitted an application to the Agency for a modification of the existing waste management licence to increase the tonnage permitted to be handled at the site and to include ships as waste which could be dealt with at the site. The application was assessed on the basis that a bund/cofferdam would be constructed, and the dock drained prior to the recovery of the scrap metal (the facility was in the past equipped with moveable dock gates which allowed the dock to be drained). On that basis, the Agency approved the modification to the waste management licence to include ships and to increase the tonnage on 30 September 2003 (Environment Food and Rural Affairs Committee, 2003).

The decision that ships was covered by the 1997 waste management licences "offshore structures" was on various grounds challenged by residents of Hartlepool. The high court decided in December 2003 that that ships were not covered by the Able waste management licence.

In order to construct the bund/cofferdam, Able UK required a planning permission from Hartlepool Borough Council, who is the Local Planning Authority. Able UK was in possession of such planning permission from 1997. In July 2003, English Nature, however, argued that the planning permission for the bund construction had expired. On the 7th October, the Hartlepool Borough Council wrote to Able UK explaining that, in the Council's view, the planning permission for the bund was not in place to construct the dry dock and made this information public. This was disputed by Able UK who suggested that preliminary works begun in 2002 were sufficient to have avoided any expiry.

On 6th October 2003, Able UK confirmed that it was the company's intention to undertake the dismantling activities in the dry dock if possible. However, the company raised the possibility that, if it was unable to resolve the dispute with the Borough Council over planning permission for the bund in its favour, it might seek to dismantle ships in wet dock conditions without a bund/cofferdam in place.

During October 2003, the UK Environment Agency reviewed their modification to the Able Waste Management Licence of 30th September and concluded that the modification could not stand, as the Agency's consideration of the application had been on the assumption that dismantling would take place in the dry dock after a coffer dam/bund had been constructed.

The Waste Management Licence modification of 30th September 2003 and whether the Agency was correct to decide that the modification should not stand came before the High Court on the 8th December. The Court decided, dismissing Able UK's arguments to the contrary, that the Agency's decision that the modification of 30th should be quashed was correct (Environment Food and Rural Affairs Committee, 2003).

The dispute between Able UK and Hartlepool Borough Council concerning whether the 1997 planning permission for the bund has lapsed, remains unresolved.

The first four MARAD vessels left US under tow in October and arrived at Hartlepool in November 2003 where they were stored in the facility.

8.6.3 Pipavav Ship Dismantling Facility, India

Pipavav Ship Dismantling Facility is located at the Pipavav Port in the State of Gujarat around 70 kilometres from Alang Beach. It is a greenfield facility, which was partly finalised in 2003, but has now stopped presumably due to the lack of financing (Harjono, 2004).

The facility is privately owned by the Gandhi family, who has raised a loan for a larger part of the investment in the Overseas Economic Corp. Fund of Japan.

Dismantling capacity and experience
The Pipavav facility covers an area of 75 hectares. The yard has two wet docks each with a length of 680 meters and widths of 60 and 65 meters respectively. Each dock is divided in a northern and a southern part with different water depth. The depth of the southern dock is decreasing from 9.4 to 6.4 meters below design high tide (5.5 to 2.5 meters below design low tide). The depth of the northern dock is decreasing from 5.4 to 2.4 meters below design high tide (1.5 meters below to 1.5 meters above design low tide).

The first 70% of the dismantling of a vessel is planned to be performed at the southern dock, after which the remaining part of the vessel is planned to be moved to the northern dock, for dismantling of the remaining 30% of the ship. From a docking capacity point of view dismantling can in theory be performed on four vessels simultaneously.

No ship has been recycled at the facility. The annual dismantling capacity, under normal conditions, is planned to be 275,000 LTD with an optimal capacity of some 400,000 LDT (MEPC 48, 2002).

HSE management
An oil spill control system is planned established at the dock entrances. This is to be used during the whole ship recycling process.

The planned flow chart for the ship recycling procedure at the Pipavav facility shows a pre-cleaning process followed by pier breaking (MEPC 48, 2002). The pre-cleaning includes tank cleaning, gas freeing and removal of hazardous materials.

8.7 Projects in development

The information search on green recycling facilities identified several projects and initiatives for development of green ship recycling. The estimated timeframe for these to be operational are longer than the timeframes for the described recycling facilities under establishment.

8.7.1 EPORT AS, Norway

Eport AS is a Norwegian shipping company located in Sandefjord. Eport AS is working on a development project with a concept for eco-friendly dismantling of end-of-life-vessels.

The business concept comprises a floating or land-based hazardous waste cleaning station aimed at cleaning and removal of onboard hazardous materials, including proper documentation to relevant agencies. The unit is planned to operate in close proximity to a number of existing scrapping yards in Asia. Contrary to the S.T.O.P. project, Eport does not plan to dismantle ships themselves, instead they will only perform the pre-cleaning of the ship before it is to be dismantled at an existing scrapping yard.

Vessels thus attend the cleaning station were they are stripped of toxic wastes and hazardous materials prior to the ship scrapping yard. Full documentation of the removal of hazardous materials are planned to be prepared and made available to the owners of the vessel. Further, a so-called green passport will be issued prior to the release of the vessel for scrapping.

All processes of the company will comply with international regulations and the company are planned to be fully certified in accordance with ISO standards (Eport, 2003).

A business plan has been drawn up for the project and Eport AS is in the process of commercialising their project. According to the company self there has been a keen interest in the market for the service (Nilsen, 2004).

The pre-cleaning capacity of the hazardous waste cleaning station is estimated to be 250,000 – 350,000 LDT/year.

8.7.2 International Marine Group, Canada

International Marine Group (IMG) are conducting ship scrapping on the Great Lakes. Their shipyard is located at the south end of the Welland Ship Canal at Lake Eire, in Port Colborne, Ontario Canada.

The company has since 1983 recycled some 40 vessels totalling around 150,000 LDT (International Marine Group, 2004). IMG is certified according to ISO 14001. According to the company, it is in fact the world's only ISO 14001 certified ship scrapper.

The company is moving forward on initiatives to add ship scrapping capacity outside the Great Lakes and hope to be operating during 2005 (International Marine Group, 2004A).

8.7.3 Update of existing breaking facilities in Bangladesh

The United Nations Development Programme (UNDP) has granted Bangladesh around 1.2 million US$ for the project “Safe and environment friendly ship recycling”.

The project will focus on the ship breaking yards operating on the beaches north of Chittagong of which a total of 32 are operating regularly (New Nation, 2003).

The project aims at bringing together all relevant parties in an effort to improve the conditions of the labour force involved and to reduce environmental pollution. The project will draw, extensively, on technical expertise from the International Labour Organisation.

The goal of the project is to align current work practises in the Bangladesh ship breaking industry with international rules and regulations. The timeframe for implementation of the project is June 2006.

8.7.4 Dutch support to development project in the Philippines

The Dutch Ministry of Environment has provided seed money for a green ship recycling facility in the Philippines as a greenfield development project. The project is relatively new and consequently progress is limited (Pijpers, 2004).

8.7.5 Further initiatives

Hariyana Group, India

The Indian ship breaking company, the Hariyana Group responded to a contact made during the study, with several proposals for them to get involved in green recycling.

According to the company's homepage (Hariyana, 2004) it is the largest ship breaking entity in the Alang belt and the first Indian ship breaking company to be certified according to ISO 9001:2000. Their three breaking plots have a combined annual breaking capacity of over 200,000 tonnes.

Declarations on green recycling of ships

According to Greenpeace (Besieux, 2004), two major ship owners, Stolt Nielsen S.A. and Mediterranean Shipping Company S.A. have each signed a declaration on ensuring green recycling of one of their ships approaching end of life. Both companies should be considering signing such green recycling declaration for their ships in general(Besieux, 2004).

Again, according to Greenpeace, the Greek company Ceres has in discussions with Greenpeace ensured that hazardous materials onboard its ships will be gradually removed as part of their regular ISO 14000 programme (Greenpeace, 2004).

Pre-cleaning

The concept of pre-cleaning the vessels receives growing attention. The basic idea is that the ship owner or his representatives perform an inventory of the ship with respect to hazardous materials, which is also foreseen in the guidelines. The inventory will allow specialised companies to remove the hazardous materials under approved procedures. The vessels can be declared clean, and the actual scrapping may begin. There are several merits to this procedure since it may be performed as identifiable tasks and responsibilities and is in line with the long established mode of work in the shipping industry.

There are, however, certain obstacles to this. The predominant procedure of scrapping involves beaching a vessel under its own power, and it must therefore be "shipshape" until actually resting on the intertidal flat. Pre-cleaning of such a vessel and removal of the bulk of hazardous materials is not possible when they form an integral part of the vessel and its engines.

Pre-cleaning would work when combined with scrapping at piers and in docks. This is the business concept of Eport AS and was also a key feature in the P&O Nedlloyds projects in China.

8.8 Dormant capacity

Depending on the future demand for green ship recycling services, new facilities will possibly enter this market. The existing ship scrapping facilities make up an obvious pool of future green recycling facilities following an upgrade of their existing scrapping procedures. In Europe, for instance, a number of scrapping facilities exist in Spain, which could possibly be upgraded.

Further, companies engaged in related businesses, possessing some of the needed technical capacity and know-how may possibly enter the market. Examples of such dormant capacity are existing ship building yards and facilities for decommissioning of offshore structures. These are described below.

Marine salvage companies could be thought of as a further possible dormant ship recycling capacity. These companies, however, most often operate in a way, where they themselves perform the work at sea until the ship/wreck is at shore. Here, the work is taken over by a sub-contractor in form of an existing ship scrapping company, which then perform the scrapping of the ship. Salvage companies operated in the traditional way, thus do not make up the most obvious dormant capacity for green ship recycling.

8.8.1 Existing dry docking capacity

Possible dormant recycling capacity is found in existing ship yards which have the necessary infrastructure and docking facilities to allow a ship to be taken out of the water and broken-up in a contained environment. This suggests dry-dock or ship lift facilities. Ship lift facilities tend to be limited to ships of up to 35,000 DWT (EC, 2000).

From a strict containment point of view, existing dry dock facilities constitute a possible capacity for recycling of ships. Off course, the availability of a dry dock facility for recycling of ships depends on other things, as for instance the cost of labour, availability of steel processing facilities (steel smelters or re-rolling facilities), down stream waste treatment facilities etc. The present status of the facility is also an important factor in the evaluation of the possibility of the facility taking up ship recycling. This is determined by the economic incentives for entering into ship recycling.

The identified large docks (>60,000 DWT) in Europe are presented in Table 8.3 and the docks outside Europe in Table 8.4. Name and location of the yards, including the large docks and the dock dimensions, are shown for the European docks. Because of the large number of docks outside Europe, only the identified number of docks in each country and the size range for these docks are shown. Name and location of the yards outside Europe is found in Appendix 9.

When considering such tables, in the light of the possibility of a dock entering the ship recycling business, it is important to notice that ship recycling is most often not considered a viable business by the yards.

Table 8.3 Existing dry-docks with a capacity above 60,000 DWT in EU including the new member states, applicant countries, Norway and Ukraine

Country	Yard	Location	Dimensions L*B*D (m)	Max weight, DWT
Belgium	Boelwerf Vlanderen	Hoboken	487 x 64	-
Bulgaria	Varna Shipyard	Varna	237 x 40	100,000
Denmark	Odense Staalskibsvaerft	Lindoe	415x90x11 (2x) 300 x 45 x 10	650,000
Finland	Aker Finnyards	Rauma	260 x 85	150,000
Finland	Masa-yards Hilsinki	Hilsinki	287 x 35	87,000
Finland	Masa-Yards Turku	Turku	365 x 80	400,000
France	L'Atlantique	St. Nazaire	450 x 90	554,000
Germany	Howaldtswerke-Deutsche Werft	Kiel	426 x 88 310 x50 230 x 44	700,000 240,000 130,000
Germany	Lloyd Werft	Bremerhaven	335 x 40	90,000
Greece	Hellenic Shipyards	Scracamanga	335 x 54 421 x 75	250,000 500,000
Italy	Fincantieri Ancona	Ancona	240 x 55	95,000
Italy	Fincantieri Breda Marghera	Mestre, Venice	250 x 36	75,000
Italy	Fincantieri Monfalcone	Monfalcone	350 x 56	350,000
Malta	Malta S.B.	Marsa	290 x 47	120,000
Malta	Malta	Malta	360 x 62	300,000
Norway	(Kvaerner)/Kleven	Ulsteinvik	280 x 34	80,000
Poland	Gdynia Shipyard	Gdynia	240 x 41 380 x 70	117,000 280,000
Rumania	Constanta Shipyard	Constanta	360 x 58 360 x 48	200,000 150,000
Rumania	Daewoo Mangalia Heavy Ind.	Mangalia	(304+322) x 48 360 x 60	220,000 400,000
Spain	Espanoles (Puerto Real)	Cadiz	525 x 100	1,000,000
Turkey	Turkiye Gemi	Pendik, Istan-bul	300 x 70	170,000
United Kingdom	Harland & Wolff SB & H. Ind.	Belfast	556 x 93	1,200,000
Ukraine	Okean	Nikolayev	360 x 60	400,000
Ukraine	Zaliv	Kherts	354 x 60	320,000

At least some 30 docks with a capacity above 60,000 DWT is found in Europe. The largest dock is found in Belfast and has a capacity of 1,200,000 DWT.

Status of the yards where the docks are found, has not been pursued. Many are engaged in ship building and ship repair.

The feasibility of turning existing European docks into a ship scrapping facility was investigated by the European Commission in 2000 (EC, 2000). The study did not surprisingly, show the economic viability for such facilities to be greatest in the lower cost economy countries of Eastern Europe and the former Soviet Union with the possibility of a negative end-of-life value for a ship in Western European countries. At least in 2000, the docks at the Gdynia shipyard were part of a highly active shipbuilding industry, leaving the docks in Romania and Ukraine with the largest potential for possible future ship recycling.

The dry dock located in Hoboken, Belgium was formerly part of the Boelwerf Vlanderen in Temse, but is now owned by the Dutch ship recycling company Scheepssloperij Nederland B.V., who hope that the market situation one day will allow the dock to be turned into a green ship recycling facility. The dock is currently hired out for production of offshore windmills (Boot, 2004).

Table 8.4 Identified docks with a capacity above 60,000 DWT outside EU. Number of docks in each country

	Country	Number of docks	Size range, DWT
South America	Brazil	1	400,000
	Chile	1	95,000
	Mexico	1	80,000
North Ame-rica	Canada	1	80,000
	United States	4	150,000 - 400,000
Asia	China	5	150,000 - 400,000
	India	1	86,000
	Indonesia	1	370,000
	Japan	15	70,000 - 800,000
	South Korea	18	150,000 - 1,000,000
	Philippines	1	73,000
	Taiwan	2	150,000 - 1,000,000
	Vietnam	1	400,000
Total		52	-

As seen from the above table, most of the large docks outside Europe are found in Asia and especially in Japan and South Korea. Status of the yards has not been pursued, but from the present size of the Asian ship newbuilding industry, there is every probability that most of the docks are engaged in ship newbuildings.

Of the 2003 worldwide order book of ship newbuildings, Asia accounts for 82 % of the compensated gross tonnage, with South Korea accounting for 38 %, Japan for 28 % and China for 13 % (Clarkson Research, 2003).

8.9 Facilities for decommissioning of offshore structures

More possible dormant recycling capacity is found in facilities performing decommissioning of offshore structures used for oil and gas production. Decommissioning of offshore structures has a lot in common with recycling of ships, as they are both large steel structures which contain hazardous materials. The offshore decommissioning facilities thus, most likely, possess most of the necessary machinery and infrastructure for recycling of large vessels.

To date, most of the industry's decommissioning experience has been in the US Gulf of Mexico where more than 1,000 structures have been removed. The removal techniques used in the Gulf of Mexico has to a large extent consisted of dynamite blasting.

There is relatively little experience of removing offshore structures from other parts of the world including the North Sea. So far, some 30 small steel structures and sub-sea installations have been successfully decommissioned. The largest fixed steel structure was removed from Norwegian waters. The Froy platform weighed 7,000 tonnes and stood in waters some 120 m deep.

Offshore decommissioning in Europe is believed to grow in the coming years, as many of the oil and gas fields in the North Sea are approaching their end of life.

The most prominent case of decommissioning of offshore structures was the decommissioning of the Brent Spar platform. This was originally planned to be disposed at a site in the deep Northern Atlantic, but following heavy protests it was instead towed to shore in Norway for decommissioning. Much of the Brent Spar structure was reused as base material for a new quay at Mekjarvik.

At present decommissioning of offshore structures is done by cutting the structure into small manageable pieces, lift them onto barges and bring them back to shore for reuse, recycling or disposal. The decommissioning is most often performed by a joint venture consisting of a large offshore lifting company and an onshore recycling company. The lifting company is performing the offshore work, cutting the facility into pieces and bringing them to the recycling company's onshore recycling facility, where the recycling work is performed by the recycling company.

Table 8.5 and Table 8.6 show the identified existing and planned European recycling facilities used for decommissioning of offshore structures.

Table 8.5 Identified operating European facilities for decommissioning of off-shore structures

Country	**Facility/Company, location**	**Experience/comments**
England	Able UK Ltd,	Has recycled 10 topsides and seven other offshore structures Involved in ship recycling, see Section 8.6
England	Swan Hunter, Newcastle upon Tyne	Facility certified according to ISO 9001 Has recycled four platforms and has performed abandonment (recycling/re-use) of further three platforms (Swan Hunter, 2004)
Shetland	Shetland Decommissioning Company Limited, Lerwick	Existing facility at the Greenhead Base. New in the market. No decommissioning performed to date
Norway	Lyngdahl Recycling, Farsund	Facility certified according to ISO 9001 and 14001 (Lyngdahl, 2003) Has recycled three main modules and has one topside in progress Has recycled seven ships of 150 - 3000 LDT (in other locations)
Norway	Aker Stord, Stord	Assembly yard with responsibility for methods and execution of topsides demolition. Has decommissioned two large topsides (Aker Stord, 2004)
Norway	Norsk Metallretur Offshore Recycling AS, Stavanger	Has a management control system in accordance with ISO 9002 (Norsk Metallretur, 2004) Has recycled around ten offshore modules Has recycled one frigate of around 1,500 LDT

Table 8.6 Identified planned European facilities for decommissioning of offshore structures

Country	Facility/Company, location	Experience/comments
Norway	AF Decom AS, Haugesund	Engaged in industrial demolition. Has recycled one ship of around 2,100 LDT. Planned establishment of offshore decommissioning facility at Haugesund to be finalised within one year. First decommission assignment agreed (Decom, 2004)
Scotland	KBR Caledonia, Nigg	Existing offshore constructions yard with large wet/dry dock. Has planning permission to decommission offshore structures
Holland	S.T.O.P., Eemshaven	Feasibility phase. See description in Section 8.6
Denmark	Esbjerg Harbour, Esbjerg	Feasibility phase
Denmark	Frederikshavn Harbour, Frederikshavn	Feasibility phase

8.10 Comments on global ship recycling capacity

The global ship breaking capacity based on beaching and pier breaking is as shown earlier, estimated to be more than adequate for the increasing scrapping needs of the shipping industry, as we have previously argued. Unless immediate change in organisation and management of these sites takes place, the future scrapping will, most likely, be performed under conditions similar to those prevailing today.

The ship recycling capacity is extremely limited concerning scrap yards already engaged in the market and employing modern health, safety and environment standards such as those promoted by the guidelines of IMO, ILO and Basel Convention. Even counting projects in various stages of planning, the global total is less than two handfuls.

The infrastructure needed for ship recycling is comparable to both ship repair/newbuilding. These facilities may be counted as dormant, but it must be borne in mind that most of these are already engaged in other profitable activities, presently the newbuilding market is booming, and when interviewed the facilities do not appear interested.

Of the stakeholders directly enganged in developing green recycling, several stated that the pre-cleaning concept is a necessity for promoting green recycling and for securing the quality of the performed recycling. The proposed idea is that the scrapping contract should include a paragraph making it compulsory that an accredited independent third-party company shall authorize the performed pre-cleaning before the vessel is released for dismantling.

For most of the facilities, registration of chemicals onboard the vessel prior to dismantling is performed by the recycling facility. According to the recycling procedures, this should be done by the ship owner before delivery of the ship to the recycling facility.

From the obtained information on the green ship recycling facilities – both active and proposed (facilities under establishment and development project) – a very optimistic estimation of the total green recycling capacity within a few years is around 2.0 million LTD. This accounts for around 30% of the predicted future scrapping demand in most years (less in peak demand years).

The future green recycling capacity can be further increased by the ongoing initiatives by ILO on introduction to green recycling in Bangladesh and the donors such as the Dutch government, which is engaged in the ship scrapping industry in Philippines.

Finally, the offshore decommissioning facilities are believed to make up a large and easy to mobilise dormant capacity, if the market situation allow for them to enter.

9 Recycling output - materials and economy

Scrapping of a ship generates a number of different material fractions. Depending on the materials composition, condition etc. these are re-used, recycled or disposed off.

Re-use and recycling may not be restricted to the re-use of single components or recycling of single materials from the ship structure, but may imply partial demolition and re-use of major elements of the original structure, e.g. engines and generators which are supplied to the local industry.

Some material fractions, e.g. steel and copper are considerable economic assets for the ship scrapping facility, whereas other material fractions have a negative value, as for instance hazardous waste.

9.1 Materials fractioning

The configuration of materials onboard a vessel varies with the size, type and function of the vessel.

The European Commission has established a generic dataset on the standard materials fractioning of older vessels (EC, 2000). The estimated dataset for standard tankers and bulkers are shown in Table 9.1.

Steel is the dominating material on both types of vessels and further the material with the largest difference in fraction of total weight between the two vessel types. Steel make up around 74 % of the total weight in tankers and around 63 % in bulkers. The reason for this is that bulkers, in general are a more simple construction than tankers.

Table 9.1 Fractioning of a typical tanker and bulker, % of total weight

	Fraction, % of total weight	
	Tanker	**Bulker**
Steel	74	63
Copper	0.01	0.04
Zinc	0.03	0.04
Special bronze	0.03	0.04
Machinery	14	19
Electrical equipment	2.5	5
Joinery	5	6
Minerals	0.5	2.5
Plastics	0.5	1.2
Liquids	2	1
Chemicals and gases	0.03	0.03
Other misc.	1	2
Total	100	100

An estimate of the future generation of material end-products from scrapping of ships can be calculated from the predicted scrapping volume and the fractions of materials in Table 9.1.

The predicted annual scrapping volume (million LDT) for the EU accelerated phase out is found by summation of scrapping volumes in Table 6.4 and 6.5. When relating the annual scrapping volumes to the materials fractions of Table 9.1 all vessels besides bulkers are counted as tankers. The resulting estimated annual material generations are shown in Table 9.2. The estimates are very rough estimates and considerable variations can occur.

Table 9.2 Estimated future generation of end-products from scrapping of ships, million ton

Million ton	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Steel	7.20	5.44	5.02	4.81	5.34	4.98	12.3	4.12	3.83	3.99	3.93	4.68	65.63
Copper	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.001	0.001	0.001	0.001	0.001	0.02
Zinc	0.003	0.003	0.003	0.002	0.003	0.002	0.005	0.002	0.002	0.002	0.002	0.002	0.03
Special bronze	0.003	0.003	0.003	0.002	0.003	0.002	0.005	0.002	0.002	0.002	0.002	0.002	0.03
Machinery	1.60	1.25	1.16	1.11	1.20	1.13	2.50	0.95	0.89	0.91	0.89	1.03	14.61
Electrical equip	0.34	0.28	0.26	0.25	0.26	0.25	0.49	0.21	0.20	0.20	0.19	0.22	3.12
Joinery	0.55	0.42	0.39	0.37	0.41	0.38	0.87	0.32	0.30	0.31	0.30	0.35	4.97
Minerals	0.12	0.10	0.10	0.09	0.09	0.09	0.14	0.08	0.07	0.07	0.07	0.08	1.10
Plastics	0.08	0.06	0.06	0.05	0.06	0.05	0.10	0.05	0.04	0.04	0.04	0.05	0.69
Liquids	0.17	0.12	0.11	0.11	0.12	0.12	0.31	0.09	0.09	0.09	0.09	0.11	1.54
Chemic./gases	0.003	0.002	0.002	0.002	0.002	0.002	0.005	0.002	0.002	0.002	0.002	0.002	0.03
Other misc.	0.14	0.11	0.10	0.10	0.10	0.10	0.20	0.08	0.08	0.08	0.08	0.09	1.25

9.2 Hazardous materials

Steel including machinery accounts for around 80 - 90% of the LDT of a ship. From an environmental point of view it is the remaining 10-20% which are the most interesting, as it includes the potential hazardous materials and substances.

Hazardous wastes and substances under the Basel Convention, relevant to ship dismantling are listed in the Basel Convention guidelines for dismantling (TWG, 2002). The ICS guidelines (Marisec, 2001) also include lists of potentially hazardous materials which may be on board vessels delivered to scrapping yards. The different lists include both specific hazardous substances and materials and products consisting of, containing or being contaminated with the hazardous substance.

The Norwegian Ministry of the Environment and the Norwegian Ship owners Association have made an inventory of materials of potential environmental concern in a VLCC of 290,000 DWT (around 37,500 LDT) built in Europe in 1976 (Norwegian Ministry of Environment, 1999). The inventory is shown in Table 9.3.

As part of the ongoing planning work for scrapping of the chemical tanker, Sandrien an inventory of the vessel has been drawn up (Shipdock Amsterdam/S.T.O.P., 2003). The amount of hazardous materials on board the vessel have not yet not quantified, but a number of items containing hazardous materials have been identified, including:

- Lead accumulators

- Nickel/cadmium accumulators
- Accumulator acid
- Insulation materials
- CFC-gas cylinders.

Table 9.3 Materials of potential environmental concern on board a 37,500 LDT VLCC ready for scrapping (Norwegian Ministry of Environment, 1999)

Component	Material	Amount
Anodes	Lead	0,4 kg [1]
	Cadmium	120 kg [1]
Electrical equipment	Batteries (Pb, H_2SO_4)	232 kg (140 kg, 44 litres)
Coatings and paints	Antifouling (TBT)	24,000 kg [2] (1,200 kg)
Refrigerants	R22/F12 [3]	900 kg
Heat insulation	Asbestos	6,000 - 8,000 kg
Electrical installations	PVC cable insulation	10,000 kg
	Light tube capacitors (PCB)	24 kg [4] (14 g)
	Light tubes (Hg)	100 kg [5] (15 g)
Oil residue	Heavy fuel oil	333 m^3
	Hydraulic oil	18 m^3
	Lubrication oil	20 m^3
	Oil sludge	1,820 m^3

1: trace elements that can not be separated from the main part of metal. Assuming 50% of the anodes have disappeared due to corrosion
2: estimated TBT-content of 5%
3: CFC-gases
4: estimated weight of 50 g/capacitor
5: estimated weight of 100 g/tube

An estimate of the future annual generation of materials of potential environmental concern, from scrapping of ships, is presented in Table 9.4. The estimate is established by assuming that the proportions of materials of environmental concern to ship tonnage for the 37,500 LDT vessel are valid for the future total scrapping tonnage.

Table 9.4 Estimated future generation of materials of potential environmental concern from scrapping of ships, ton (densities used: H_2SO_4: 1.85 kg/l; paints: 1.4 kg/l; oils: 0.85 kg/l; oil sludge: 1.6 kg/l)

Hazard-ous mate-rials, ton	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Lead	0.11	0.08	0.08	0.07	0.08	0.08	0.18	0.06	0.06	0.06	0.06	0.07	**0.99**
Cadmium	32.6	25.0	23.0	22.1	24.3	22.7	54.1	18.9	17.6	18.2	17.9	21.1	**298**
Pb	38.1	29.1	26.9	25.8	28.4	26.5	63.1	22.0	20.5	21.3	20.9	24.6	**347**
H_2SO_4	22.1	16.9	15.6	15.0	16.5	15.4	36.7	12.8	11.9	12.4	12.2	14.3	**201**
Paints	12566	9610	8870	8501	9363	8747	20821	7269	6776	7022	6899	8131	**114576**
TBT	326	250	230	221	243	227	541	189	176	182	179	211	**2976**
R22/F12	245	187	173	166	182	170	406	142	132	137	134	158	**2232**
Asbestos	1904	1456	1344	1288	1419	1325	3155	1101	1027	1064	1045	1232	**17360**
PVC	2720	2080	1920	1840	2027	1893	4507	1573	1467	1520	1493	1760	**24800**
PCB	0.004	0.003	0.003	0.003	0.003	0.003	0.006	0.002	0.002	0.002	0.002	0.002	**0.03**
Hg	0.004	0.003	0.003	0.003	0.003	0.003	0.007	0.002	0.002	0.002	0.002	0.003	**0.04**
Oils	85775	65593	60547	58024	63911	59706	142118	49615	46251	47933	47092	55502	**782068**
Oil sludge	792064	605696	559104	535808	590165	551339	1312341	458155	427093	442624	434859	512512	**7221760**

9.3 Price of green recycling

9.3.1 Introduction

The number of facilities offering green recycling is limited in Europe and globally. Until recently, the market for such services has been limited to a few governmental programmes and concerned companies. Thus, benefits from large scale activities and competitive forces from comparable facilities have not yet been brought into play. Green recycling of ships is, generally, considered more expensive that traditional breaking.

In the following sections the available economic data on the existing and proposed green ship recycling facilities are presented. Economic information delivered for anonymous use for the study from stakeholders within the ship scrapping industry is further presented together with estimates of some of the extra costs associated with green recycling.

The economic information is indicative and can not be used for more in-depth economic analysis.

9.4 Cost estimates for green recycling

No specific information on the extra cost of performing green recycling of a ship, compared to traditional breaking, has been identified, but a number of approximations can be made. A precise indication of this would require one facility being able to perform both traditional breaking and green recycling giving two proposals for scrapping of one vessel.

A rough indication of the maximum price difference can be found by studying the scrapping prize per LDT obtained at the same time in different countries. Estimated price differences in 2002 of up to 1.2 to 1.5 million USD of max prices of up to 3.2 million USD for standard tankers and bulkers between European and Asian scrapping facilities have been reported (Danish EPA, 2003). The environmental standards at these facilities have not been investigated, but the standard of the European facilities were believed to be higher than the Asian facilities. Some of these reported price differences can be assigned to extra green measures, but does of course also cover differences in wage level etc.

The cost of performing pre-cleaning of a ship and disposal of hazardous waste is estimated to be around 25 - 50 USD/LDT in Asia and slightly higher in Europe. This estimate is based on information from several industry stakeholders, but is not verifiable within the present study.

The extra cost for performing green recycling is made up by:

- manpower costs for new and more time consuming working routines for the workers engaged in the ship recycling process,
- hazardous waste disposal costs,
- construction costs for new equipment, machinery and infrastructure necessary for safe separation and containment of hazardous materials from the ship.

Estimates on these costs are presented below.

Manpower costs
The new and more time consuming work routines increase the number of man-hours used for the dismantling process and thereby the operating costs of the recycling facility.

The time used for pre-cleaning a ship of 10,000 - 25,000 LDT before scrapping is initiated, has been estimated to around 4 to 7 weeks depending on the size of the vessel. This extra work load and cost stems almost entirely from requirements related to green measures.

Cost for disposal of hazardous waste
To give an indication of the order of magnitude of the costs associated with disposal of hazardous waste, examples of Danish disposal costs for the relevant

hazardous waste fractions are listed in Table 9.5. The resulting disposal costs for the VLCC vessel described in Table 9.3 are further calculated.

The prices are catalogue prices from the leading Danish company for treatment of hazardous waste and waste with an environmental impact and cover waste delivered in drums. Reductions can be obtained for delivery of large shipments.

Table 9.5 Examples of disposal costs for hazardous waste (Lauridsen, 2004). Calculated costs for disposal of hazardous materials on board 37,500 VLCC vessel (based on inventory from Norwegian Ministry of the Environment, 1999)

Compounds	Disposal cost, USD/ton	Calculated costs for waste disposal from 37,500 VLCC vessel, USD
Batteries: Pb, H_2SO_4	175	37
Antifouling: TBT	506	12,150
Refrigerants: R22/F12	3,400	3,060
Heat insulation: Asbestos	950	5,700 - 7,600
Cable insulation: PVC	288	2,875
Fluorescent light tubes: Hg	2,413	241
Electrical capacitors: PCB	3,400	81
Oil residues	231 - 281	746,325 - 907,687
Total	-	770,432 - 933,695

Construction costs

The capital costs for a green recycling facility are, of course, dependent on the capacity and the starting point of the facility - a greenfield development is much more expensive than extension or upgrading of an existing facility. Further, local factors as the wage level, additional infrastructure needed etc. will influence the size of the costs.

The cost of establishing a greenfield European green recycling facility was in year 2000 by DNV estimated to around 96 million USD (EC, 2000). About 70% of these costs are for establishment of dry dock and dockside areas. The capacity of that facility was the in that study forecasted annual throughput of European vessels (OECD or geographical Europe).

In India, the total investment for establishment of the Pipavav recycling facility after a finalisation of the yard is reported to be around 90 million USD (MEPC 48, 2002). The annual capacity of the Pipavav facility is optimal 400,000 LDT (maximum 2.8 million DWT).

The investment costs for the S.T.O.P. facility is according to S.T.O.P. themselves around 50 million EURO. This cost is for a fully operational facility at Eemshaven with an annual capacity of 200,000 LDT (Mulder, 2004).

According to Eport AS, the estimated investment cost for a fully operational floating hazardous waste cleaning station is 10-15 million USD (Nilsen, 2004). This facility must operate in conjunction with a scrapping yard. The estimated annual cleaning capacity of the waste cleaning station is 250,000 - 350,000 LTD/year.

The above mentioned investment costs are summed up in Table 9.6.

Table 9.6 Investment costs, USD for establishment of green recycling facilities (0.80 EURO/USD)

Facility	Location	Facility cost, USD
Example EC yard	EC	96
Pipavav	India	90
S.T.O.P.	The Netherlands	63
Eport	Asia	10 - 15

The depreciation costs must best be covered by the facility earnings. Depreciation of facilities installed solely as a green measure will be regarded as an additional cost related to operation of a green recycling facility. The depreciation period for a ship recycling facility will typically be around 20 - 30 years.

10 Promoting green recycling capacity

These recommendations rest on the assumption that competent authorities of the EC consider it unacceptable that tankers phased out as a consequence of the Directive 417/2003 or the amended IMO regulation are scrapped under the conditions predominant in Asian ship breaking today. It is clear from this study that there is insufficient capacity for green recycling globally, and although some is planned in Europe we are running late if a European capacity shall be developed in due time to service a significant number of vessels.

This study is not directed towards policy development, but includes a number of issues regarding promotion of green recycling are addressed below. However, regardless of the instruments chosen the core questions are:

- How do we get more green recycling capacity?
- How do we get more ship owners to use it?
- How can we provide more incentive
- (and who is going to pay for all that?)

The means to avoid an uncontrolled scrapping practise of phased out vessels are difficult to implement. In fact very few single hulled oil tankers are directly affected by the Directive since most do not operate under European flags excl. the new member states Cyprus and Malta, and it is expected that the latter two states will experience considerable reflagging of the said tankers. Thus, there are no legal obstacles to the transfer of the single hulled tanker fleet away from EU flags to continued operation under flags, for which the accelerated phase out will only come into effect with the amended IMO regulation in 2005. In some flag states the implementation and enforcement of regulation regarding these issues is somewhat lax. At some point the competent European authorities could choose to consider a certain reflagging rate and sale volume of former European flagged single hull oil tankers as a *de facto* evasion of applicable EC regulation regarding ship scrapping leading to export to the existing sub-standard facilities.

However, it is expected that single hulled tankers directly affected by EC regulation and designated to be scrapped in EU will be few. The concern therefore is mainly directed towards the general volume of single hull tankers to be phased out, which operate under other flags. It is assumed that EU will only support green recycling alternatives, which comply with the recommendations in the guidelines. Not considering means and measures of how to ensure that available green recycling facilities are actually used two possible alternatives for green recycling of ships can be outlined:

- Use the presently available capacity of European green recycling facilities and expand the capacity in Europe.
- Upgrading existing dismantling facilities in third world countries to a green recycling standard.

To achieve these objectives and avoid the scrapping of ships under unacceptable conditions a number of actions can be envisioned. Basically, three types of instruments available for handling this situation:

- Regulation. Implementation of enforceable regulation on a globalised industry has limited possibilities on EU scale beyond the existing directives, but other fora exist, e.g. IMO.
- Economic instruments. A number of instruments allowing ship owners to choose acceptable scrapping have been brought forward.
- Information. Raising awareness among ship owners, authorities in breaker countries, workers and other stakeholders.

A brief discussion of the applicability and effect of these instruments is given below.

10.1 Regulation

The regulations governing transport by and sale of ships have been developed for and by a truly global industry over more than 200 years. A great number of mechanisms have been developed to allow vessels to be identified, repaired, sold, leased, and operated etc. under one or at least very few sets of regulations around the Globe. Regarding the end-of-life situation, regulation of ship scrapping as a land based activity has been considered a matter of national authorities and no responsibility is placed on the ship owner in that respect.

Although the Basel Convention and the European Waste Shipment Regulation already applies to the scrapping issue, it has been very difficult to prove a ship owner's intent to dispose. If there is intent to avoid ending up with a vessel that must be scrapped under acceptable procedures in EU or similar green recycling conditions there are amble opportunities to do so legally. The few owners that comply today do so voluntarily as a result of company policies. Brokers and cash buyers may also be compelled to choose exclusively between such yards due to the company policies of the seller, but at present it is only few companies that have instigated such policies.

The development of a common guideline is the topic of the tripartite negotiations between IMO, Basel Convention secretariat and ILO. Provided such a guideline is mandatory and implemented in the countries in question it will assist in transforming the industry. However, the market driven demand is not strong, and if ship breaking moves to new locations not enforcing the regulation very little is gained.

Several companies in the EU are developing capacity for green recycling, but none see a profitable business in direct competition with Asian ship breaking yards. There are only limited options for forcing scrapping in EU if ships are reflagged before scrapping and it may be argued that green recycling of a vessel can be carried out equally good in Asia and in EU, if properly developed. Even if Asia is accepted as the present and future prime ship scrapping destination problems remain in developing technical solutions to the extent of the necessary pre-cleaning of ships, the non-continued use of the beaching approach and other requirements of the existing guidelines.

The options for improving the regulatory side may include:

- Mandatory implementation of guidelines under IMO
- Take-back approach for construction yards
- Global fund fuelled with levies from the shipping industry to finance scrapping of the individual vessel

The embedded challenges in implementing mandatory guidelines via IMO timely relative to the peak in phase out volume are significant, and may involve use of economical and information instrument to facilitate the process.

Developing a "take-back" approach charging the building yards with the responsibility to have the vessels demolished have virtues in terms of forcing product sustainability thinking onto the makers, but the 25 years time lag is problematic.

A global fund has been proposed and is a possibility although only a truly global levy system will ensure coverage. A problem is that it may have to be the owner of today that end up paying for the years of usage by other owners.

10.2 Economic instruments

The largely unregulated existing ship breaking capacity in Asia has for some time now been in the spotlight for not adhering to even basic concerns for health, safety and environment. The market is very competitive on price and the industry has historically been seen to respond to increasing costs and legislative demands by movement of the clusters of breakers to countries of low cost, higher demand for recycled steel and a lax enforcement of regulation. Unless instruments are developed and/or regulations are implemented and enforced to avoid this, the incentive will be to continue the procedures as hitherto, possibly in new locations.

As green recycling means extra costs this raises the question of who shall carry the costs for green recycling? Should it be tax payer financed or should the costs be paid by the ship builders or the ships owners? There is very little incentive to take a tanker off the market in the present situation, since the freight rates have not been better for years. However, steel prices are also at their all time high at some 400 $/LDT (up 3-4 times in two years), and there may be some room for the additional cost of green recycling, if available. But from an economic point of view there is very little incentive to choose green recycling in Europe or elsewhere compared to standard ship breaking in Asia.

Not considering the question of who shall carry the costs, using subsidies is the simplest way of making green recycling economically attractive. Moreover, subsidies can be used as a mean to provide a sufficient incentive for the ship owners to sell their ships to recycling facilities complying with the guidelines. Subsidies can take different routes, e.g.:

- Support to the green facilities to increase their competitiveness, e.g. R&D, technical assistance, procurement of equipment.
- Subsidies, tax benefits etc. to ship owners using green recycling.

Increased support to development of green facilities in EU and to the improvement of Asian breaker yards probably could deliver "fast track" solutions by upgrading existing facilities.

The subsidy could be paid directly to ship owners choosing an approved green recycling facility. The subsidy needs to be of a size which makes the total benefit (subsidy plus price paid by the ship scrapper) of choosing a green recycling facility as high as choosing an existing non-complying facility.

10.3 Information

There is already a considerable attention to the conditions of ship breaking from involved international and national authorities. Several parties within the Industry, NGOs and trade organisations are involved in the international work on the issue. Raising the awareness in the countries in question is more difficult, let alone change the existing conditions on the short term basis. It must be borne in mind that several hundred thousand people depend for their living on this industry, however dirty and dangerous the work is. Nevertheless, the conditions may change over the coming years due to the attention and the assistance from international organisations and national donor organisation.

The immediate reaction solely from the point of view of concern for health, safety and environment during the ship breaking may be to ban all scrapping in third world countries until the breaking activities are up to the mark. Aside from its well known problems, the ship breaking is an industrial activity which is exactly what one would ask a responsible business area to do, namely to make sure that the assets are recycled; to consider the end-of-life product not as waste, but as a resource. Thus, correctly carried out the activity in itself is a sign of sustainability. Secondly, in the countries presently involved in ship breaking the steel in particular, but also other reusable items obtained through ship breaking make important contributions to the development of local economy. Thirdly, a great number of underprivileged people are locally dependent on the ship breaking industry. For example, in the Chittagong area in Bangladesh it is estimated that besides 25,000 workers directly employed in breaking, an additional approx. 100,000 people are engaged downstream (ILO 2001). This means that probably more that half a million people in that area depends on the industry for their living. The consequences of a sudden unmitigated enforcement of regulations on the scrapping activities would be catastrophic in the areas engaged in the beach breaking today.

It is therefore suggested that the following is taken into consideration:

- Inclusion of the issue in bilateral agreements with relevant countries to bring attention to the matter.

- Technical assistance to the development and implementation of national roadmaps to improved conditions in breaker yards.

- Assistances to shipping industry, e.g. with development of certification/auditing activities for green recycling facilities and lists of approved facilities.

For the developing countries, the implementation of the relevant guidelines on ship scrapping would necessitate massive investment in adequate waste reception facilities at the recycling yards and environmentally sound waste management systems to ensure compliance with the green recycling guidelines.

Due to lack of economic incentives, these investments are not likely to happen by themselves. One solution could be to develop and promote global a programme with a strategy for resource mobilization from donors such as European Development Bank, World Bank, Asian Development Bank, the Global Environment Facility, UNDP and bilateral donors to technical assistance to the facilities in third world countries.

Various instruments besides "command and control" can be brought into use to either support the European or the developing countries in green recycling. These may in Europe include support from EU R&D programmes, regional and Small and Medium sized Enterprises development programmes or direct subsidies. There are several green recycling initiatives in EU Member States that can provide good practice working methods that could be promoted at international level and/or exported to developing countries. Those initiatives would prove that environmentally sound recycling practices are compatible with an economically viable recycling activity. Nevertheless, the successful promotion of those practices in third world countries would require mandatory international regulation in view of current market mechanisms.

In the developing countries contributions to the development of workers health and environmental awareness and protection are a core element in a number of donor organisation strategies to support capacity building, training, equipment, auditing etc.

The possibility exists for a green recycling capacity to be developed, but the lack of legal and economic incentive for establishing a large scale green recycling capacity for the global market is evident in the ship breaking industry today.

11 Conclusions

The study has examined the most recent information and otherwise included information in particular from studies performed over the last five years. A number of key players in industry, international and national organisations and non-governmental organisations have been contacted, and have provided valuable first-hand information to the study.

Phase out volume

The agreement of the IMO and new legislation in EC both accelerating the phase out of single hull oil tankers will lead to more vessels being scrapped in particular in 2010. Future scrapping volumes of up to 16 million LDT in the peak year are considerable higher than the historical recorded scrapping volumes with a mean annual scrapping volume in year 1994 - 2003 of 4.7 million LDT and a maximum of 6.4 million LDT, recorded in 1999. The worst case scenario assumes that none of the exemptions possible under the IMO regulation is used. This is in practise not likely since for example a number of major flag states (Panama, Liberia, Bahamas, Brazil, India or Russia) are likely to apply for such exemptions, and the theoretical peak in phase out volume will be lower and distributed over several years.

Scrapping capacity

It is a conclusion of the study that there is no evidence of capacity constraints in the ship scrapping industry historically. The scrapping quantity observed in the market is merely the volume provided at that specific point in time to match demand. In other words, the historical annual scrapping maximum seen in 1999 does not describe the maximum capacity of the scrapping industry using the currently applied practices. Thus, because the increased demand related to phase out of tankers is foreseeable and because of the flexibility in the existing scrapping capacity, the indications are that the projected scrap volume can be absorbed by the largely unregulated ship breaking capacity of the beaches and breaker yards in Asia. The demand for tanker scrapping capacity has reportedly already led companies to consider expanding their facilities and setting up facilities in new countries, and previous scrapper countries (Vietnam, Philippines) to consider re-entering the market.

Thus, if the ship scrapping flowing from the projected phase out of oil tankers is allowed to be carried out under the well known poor conditions of the Asia breaker beaches it may be expected that the demand for scrapping capacity will be met.

Recycling guidelines

If the above mentioned section of the ship breaking industry is not considered acceptable a number of guidance documents for safe ship scrapping exist. During recent years the international focus on the environment and health problems in the ship breaking industry have been raised. As a result of this a set of inter-related guidelines for ship recycling have recently been developed and adopted in the context of the IMO, the Basel Convention and the ILO respectively. The guidelines deal with the requirements at different stages of the ship scrapping process. IMO deals with requirements before the ship enters the scrapping facility, the Basel Convention with requirements primarily regarding dismantling of ships at the recycling facilities and ILO deals with the safety and occupational health aspects throughout the entire process. None of the guidelines are mandatory or legally binding.

In addition to the above mentioned guidelines, an Industry Code of Practice on Ship Recycling and a special Demolition Contract has been prepared by industry organisations, and a set of guidelines for ship scrapping in the United States has been developed by the United States Environmental Protection Agency.

"Green recycling"

Only a few recycling facilities claim to perform ship scrapping in an acceptable way in relation to environmental impact and workers health and safety - "green recycling". Green recycling is ideally defined as scrapping performed in full accordance with the applicable recycling guidelines. There is no certification practise for this yet and it has not been a part of the study to evaluate, inspect or audit the dismantling procedures for specific facilities for their compliance with the recycling guidelines. Thus, for the purpose of this study, the world market has been scanned to identify both active and proposed green recycling facilities, and the green ship recycling facilities have been identified based on the facilities own statements (advertisements, homepages, interviews etc) and other volunteered information.

Green recycling capacity

The identified existing green recycling capacity for larger tankers is limited and may optimistically reach around 780,000 LDT/year. Most of this capacity is found in China as seen in the table below.

Country	Existing green recycling capacity LDT/year
Italy	80,000
Belgium	120,000
Holland	30,000
China	550,000 *
USA	N/A
Total	780,000

*: The total yard capacity of two yards that has performed green recycling - not all may be approvable for green recycling

Further, a number of green recycling facilities under establishment and green recycling development project have been identified. For some of these the expected green recycling capacity is known. These capacities, together with the existing facilities, including planned extension at one yard, can within a few years bring the annual green recycling capacity up to around 2 million LTD. This recycling capacity account for around 30% of the predicted future scrapping demand in most years but less in the peak demand years. In most European countries yards engaged in ship scrapping exist, but they are typically small and scrap fishing vessels and other vessels up to 5,000 DWT.

Recommendations

It is assumed that EU will only support green recycling alternatives, which comply with the recommendations in the guidelines. Not considering means and measures of how to ensure that available green recycling facilities are actually used two possible alternatives for green recycling of ships can be outlined:

- Use the presently available capacity of European green recycling facilities and expand the capacity in Europe.

- Upgrading existing dismantling facilities in third world countries to a green recycling standard.

A brief catalogue of options for promoting green recycling in EU and in the present breaker countries includes developing improved regulation, economic incentives and awareness raising:

- Mandatory implementation of guidelines under IMO,
- take-back approach for construction yards (long term),
- a Global fund fuelled with levies from the shipping industry to finance scrapping of the individual vessel (long term),
- support to the green facilities to increase their competitiveness, e.g. R&D, technical assistance, procurement of equipment
- subsidies, tax benefits etc. to ship owners using green recycling,
- inclusion of the issue in bilateral agreements with relevant countries to bring attention to the matter,
- technical assistance to the development and implementation of national roadmaps to improved conditions in breaker yards,
- assistance to shipping industry, e.g. with development of certification/auditing activities for green recycling facilities and lists of approved facilities.

The possibility exist for a green recycling capacity to be developed, but the lack of legal and economic incentive for establishing a large scale green recycling capacity for the global market is evident in the ship scrapping industry today.

12 References

Able UK, 2004. www.ableuk.com/shiprecycling-news.shtml.

Ahmed, 2003. Personal communication with Mr. Moin Ahmed, permanent representative of Bangladesh to IMO, December 2003.

Aker Stord, 2004. Personal communication with Aker Stord, March 2004.

Besieux, 2004. Personal communication with Mr. Martin Besieux, Greenpeace International, Belgium. February 2004

BIMCO, 2001. *Decommissioning and Recycling of Ships and the Capacity of the Recycling Industry*, report prepared by MSR-Consult, 2002.

Blankestijn, 2004. Personal communication with Mr. Tom Peter Blankestijn, Manager Maritime Policies and Regulatory Affairs P&O Nedlloyds. January 2004.

Boot, 2004. Personal communication with Mr. Boot, Scheepssloperij Nederland B.V., January 2004.

Business Standard, 2003. http://www.business-standard.com/today/story.asp?Menu=23&story=29568. December 11 2003.

Clarkson Research, 2003. Global Order Book.

Danish EPA, 2003. Ship breaking in OECD. Working Report No. 17, 2003.

Decom, 2004. Personal communication with AF Decom AS, March 2004.

EC/CESA, 2003. LeaderSHIP 2015 working papers, 2003

Eport, 2003. Floating hazardous waste cleaning station. An eco-friendly service for cleaning and preparation for ship dismantling. Prospect version: 25/08/2003 10:15. Developed by Eport AS, Sandefjord/Norway. (Proprietary information)

EC, 2000. *Technological and economic feasibility study of ship scrapping in Europe*, report prepared by Det Norske Veritas - Appledore International, 2000

Environment Food and Rural Affairs Committee, 2003. Inquiry into United States "Ghost Ships". Supplementary evidence from the Environment Agency following hearing on 19 November 2003. http://www.environment-agency.gov.uk/commondata/103599/efra_com_evidence_630119.doc

Frontline World, 2004. A member of the fleet: The Sea Beirut - Still toxic. http://www.pbs.org/frontlineworld/stories/spain/liberia.html

Greek Shipping Co-operation Committee, 2003. *E.U. Proposals for the Accelerated Phase out of Single Hull tanker*, note prepared by Clarkson Research, 2003.

Greenpeace, 2003. *Playing hide and seek*

Greenpeace, 2004. Greenpeace Ship breaking site: www.greenpeaceweb.org/shipbreak/

Guardian, 2003. Environmentalists welcome ruling against ghost ship licence. Tuesday December 9, 2003.

Hariyana, 2004. http://www.hariyanagroup.com/home.htm

Harjono, 2004. Personal communication with Ms. Mariette Harjono, Greenpeace, March 2004.

ILO, 2001. Sectoral Activities Programme. An Issue Paper. Worker safety in the ship breaking industries. Aage Bjørn Andersen. International Labour Office, Geneva, February 2001.

ILO, 2003. Draft guidelines on safety and health in ship breaking. Interregional Tripartite Meeting of Experts on Safety and Health in Ship breaking for Selected Asian Countries and Turkey. Bankok, 20-27 May 2003. International Labour Office, Geneva.

IMO, 2003. Guidelines on Ship Recycling. International Maritime Organisation MEPC 49/WP.15, Annex 2.

International Marine Group, 2004. Homepage of International Marine Company. http://www.rawmaterials.com/imsmain.htm

International Marine Group, 2004A. Letter to Cowi A/S dated February 1st 2004

INTERTANKO, 2002. *Phasing out Single Hull Tankers - the 2001 amendments to Annex 1 of MARPOL*

INTERTANKO, 2003. Single hull tanker phase out comparison IMO 13G - EU proposal, presentation

Laurdisen, 2004. Internal Cowi note on prices for disposal of hazardous waste prepared by hazardous waste expert Mr. Jørn Lauridsen, Cowi A/S. March 2004.

Llloyd's, 2004. http://directory.fairplay.co.uk/showarea.asp?area=Ship+Breakers. 3 February 2004.

Luttikhuizen, 2004. Personal communication with Mr. Cees Luttikhuizen, Netherlands Ministry of Spatial Planning, Housing and the Environment, February 2004.

Lyngdal, 2003. Lyngdahl Recycling AS, Site Description. Revision 01, 07.08.03

MARAD, 2003. http://www.marad.dot.gov/research/Needs/Environment.html

Marisec, 2001. Industry Code of Practice on Ship Recycling. Marisec. August 2001.

Marshall, 2004. Personal communication with Mr. Clive Marshall, ABLE UK, February 2004

Martin Stopford, 2000. *Maritime Economics*, Routledge, 2000.

MEPC 44, 2000. The case of MV Forthbank - Belgium December 1999: A legal precedent for the application of the EU Hazardous Waste Export Ban to toxic ships bound for scrapping in Asia. A greenpeace Report for IMO MEPC 44th Session - March 2000. http://archive.greenpeace.org/toxics/reports/forthbank.html

MEPC 48, 2002. Pipavav Ship Dismantling Facility, Gujarat, India. Presentation to MEPC - 48th Session. International Maritime Organization (IMO), London, United Kingdom. 09 October 2002.

Mulder, 2004. Personal communication with S.T.O.P. Chairman Mr. Doebren Mulder, March 2004

Neetc, 2004. http://www.neetc.iup.edu/cgi-bin/display_record.pl?2004-02-16-001

New Nation, 2003. $1.2 million UNDP grant for safe ship breaking project. 19 November 2003

Nilsen, 2004. Personal communication with Mr. G. F. Nilsen, EPORT AS, January.

Norsk Metallretur, 2004. http://www.metallretur.no/english/offshore.htm

Norwegian Ministry of the Environment, 1999. Decommissioning of Ships. Environmental Protection and Ship Demolition Practices. Norwegian Ministry of the Environment and Norwegian Ship owners Association. Technical Report. Report No 99-3065 Revision No. 03.

P&O Nedlloyd, 2003. Ship-recycling Standard Operating Procedures FMD/LFC Departments. Jeroen Schuering, 12th June 2003. (Proprietary information)

Pijpers, 2004. Personal communication with Mr. Reinoud Pijpers, Ministry of Transport, Public Works and Water Management the Netherlands

Poten & Partners, 2004. *"Decisions, Decisions, Stratospheric Scrap Prices: What's An Owner to Do?*

Shipdock Amsterdam/S.T.O.P.. Inventarisatierapport M/S Sandrien. December 2003 (Proprietary information)

Shiprecycling, 2004. The Ship Recycling Bulletin. http://www.shiprecycling.org

S.T.O.P., 2004. Ecodock Eemshaven Business Plan. On behalf of the Tanker and Platform Dismantling Foundation (S.T.O.P.). Elmar Management B.V. and Beaureaal B.V. Haren/Eemshaven, 13. January 2004. (Proprietary information)

Swan Hunter, 2004. Presentation material received from Swan Hunter March 2004.

Turkish Ministry of Environment and Forest. Letter to the Basel Convention Secretariat dated 14th November 2003.

TWG, 2002. Technical Guidelines on Environmentally Sound Management for Full and Partial Dismantling of Ships, Draft. Report No. APR/TWG 20. Revision No. 01. The Technical Working Group (TWG) of the Basel Convention.

US EPA, 2000. United States Environmental Protection Agency. A Guide for Ship Scrappers: Tips for Regulatory Compliance. Summer 2000.

Van Heyghen Recycling, 2004. Fax to COWI A/S dated January 5th 2004.

Van Heyghen Recycling, 2004A. Fax to COWI A/S dated January 16th 2004.

Wyntin, 2004. Personal communication with Peter Wyntin, Van Heyghen Recycling, January 2004.

13 Appendix

13.1 Appendix 1: Segmentation

13.1.1 Shipping segments

The table below shows segmentation of the vessels into "main types" and the relevant size ranges.

Table 13.1 Unit conversion by main type and size range

Main vessel type	Size range
(Single hull) oil tanker	>200,000 DWT
	120-200,000 DWT
	80-120,000 DWT
	60-80,000 DWT
	40-60,000 DWT
	<40,000 DWT
Other tanker	>200,000 DWT
	120-200,000 DWT
	80-120,000 DWT
	60-80,000 DWT
	40-60,000 DWT
	<40,000 DWT
Bulk carrier	>80,000 DWT
	60-80,000 DWT
	40-60,000 DWT
	<40,000 DWT
Container	>60,000 DWT
	40-60,000 DWT
	20-40,000 DWT
	<20,000 DWT
Gas	>30,000 DWT

	10-30,000 DWT <10,000 DWT
Passenger/ro-ro/vehicle	>10,000 DWT 5-10,000 DWT <5,000 DWT
Other cargo vessel	>40,000 DWT 20-40,000 DWT 10-20,000 DWT <10,000 DWT
Non- cargo vessel	>40,000 DWT 20-40,000 DWT 10-20,000 DWT <10,000 DWT

The segmentation is based on the following spilt of sub-types (note that for the historical analysis no distinction is made between the hull type of oil tankers, i.e. all oil tankers are included in the first segment):

(Single hull) oil tanker (<u>*shown types of oil tankers which are single hull*</u>): Asphalt & bitumen carrier, bunkering vessel, chemical & oil carrier, molten phosphorous carrier, molten sulphur carrier, naptha carrier, product carrier, shuttle tanker, sulphuric acid tanker, tanker.

Other tanker: Ethylene, fleet replenishment vessel, fruit juice carrier, methanol carrier, palm oil carrier, phosphoric acid carrier, product carrier/heavy lift, sewage disposal carrier, slurry carrier, vegetable oil carrier, water carrier, wine tanker <u>+ shown types of oil tankers which are double hull</u>: Asphalt & bitumen carrier, bunkering vessel, chemical & oil carrier, molten phosphorous carrier, molten sulphur carrier, naptha carrier, product carrier, shuttle tanker, sulphuric acid tanker, tanker.

Bulk carrier: Bauxite carrier, bulk carrier, bulk/oil carrier, cement carrier, chip carrier, forest product carrier, gypsum carrier, limestone carrier, log carrier, lumber carrier, minibulker, nickel carrier, ore carrier, ore/oil carrier, stone chip carrier, sulphur carrier, urea carrier.

Container: Fully cellular container.

Gas: Chemical & LPG carrier, Ethylene/LPG, Ethylene/LPG/chemical, LPG carrier,Oil & liquid gas carrier.

Passenger/ro-ro/vehicle: Naval ro-ro logistics vessel, pure car carrier, reefer/pass./ro-ro, reefer/ro-ro cargo, ro-ro, ro-ro freight/passenger, ro-ro/container, ro-ro/lo-lo, ro-ro/passenger/cargo, vehicle carrier.

Other cargo vessel: Barge carrier, chemical & ore carrier, floating production storage unit, floating storage unit, general cargo liner, general cargo tramp, heavy deck cargo carrier, heavy lift cargo vessel, live stock carrier, LNG, LNG/ethylene/LPG, LPG/chemical, LPG/oil, LPG/solvents, miscellaneous, miscellaneous vessel, multi-purpose, open hatch carrier, pipe carrier, reefer carrier, reefer fish carrier, reefer/container, reefer/fleet replen., reefer/general cargo, reefer/pallets carrier, salt carrier.

Non-cargo vessel: Anchor handling tug, Anchor handling tug/supply, cable layer, crew boat, diving support, gravel/stone discharge, heavy lift/crane ship, maintenance, mooring, multi-functional support, oil well service, oilfield pollution control, pipe layer, platform supply, reefer fish factory ship, rov/submersible support, standby/rescue, supply, survey, utility/workboat, whale factory vessel.

13.1.2 Regions

The table below shows the regional segmentation.

Table 13.2 Regions

Country group	Countries included (reference in database)
Bangladesh	Bangladesh
India	India
Pakistan	Pakistan
Indian Sub Cont	India/Bangladesh, Indian Sub Cont
China	PRC
Vietnam	Vietnam
Other Asia	Japan, Philippines, Taiwan, Thailand
EU	Denmark, Dutch, Italy, Netherlands, Portugal, Spain, U.K.
Turkey	Turkey
North America	Canada
South America	Brazil, Columbia, Peru, Venezuela
Mexico	Mexico
Other/Unknown	Cuba, Egypt, Libya, Unknown, (blank)

Note: "Indian Sub Cont" means that it can be from any of the three countries; India, Bangladesh or Pakistan.

13.2 Appendix 2: Unit conversion

The table below shows the unit conversion factor used for each main type and size range. For some types/size ranges only very few observations are available. Accordingly, it has not been possible to estimate the parameters for these on the basis of historical observation. These are marked with an * in the table.

Table 13.3 Unit conversion by main type and size range

Main vessel type	Size range	LDT/DWT
(Single hull) oil tanker	>200,000 DWT	0.14
	120-200,000 DWT	0.16
	80-120,000 DWT	0.18
	60-80,000 DWT	0.19
	40-60,000 DWT	0.22
	<40,000 DWT	0.28
Other tanker	>200,000 DWT	0.14*
	120-200,000 DWT	0.16*
	80-120,000 DWT	0.18*
	60-80,000 DWT	0.19*
	40-60,000 DWT	0.22*
	<40,000 DWT	0.28*
Bulk carrier	>80,000 DWT	0.18
	60-80,000 DWT	0.19
	40-60,000 DWT	0.22
	<40,000 DWT	0.26
Container	>60,000 DWT	0.50*
	40-60,000 DWT	0.53
	20-40,000 DWT	0.48
	<20,000 DWT	0.49
Gas	>30,000 DWT	0.37
	10-30,000 DWT	0.51
	<10,000 DWT	0.61
Passenger/ro-ro/vehicle	>10,000 DWT	0.62
	5-10,000 DWT	1.17
	<5,000 DWT	1.85
Other cargo vessel	>40,000 DWT	0.26
	20-40,000 DWT	0.34
	10-20,000 DWT	0.39
	<10,000 DWT	0.67
Non- cargo vessel	>40,000 DWT	0.48*
	20-40,000 DWT	0.48
	10-20,000 DWT	0.60
	<10,000 DWT	1.05

13.3 Appendix 3: Average life time expectancy

The table below shows the average life time expectancy by type of vessel and size group.

Table 13.4 Average life time expectancy by type of vessel and size group

Main vessel type	Size range	Historical average lifetime (years)
Oil tanker	>200,000 DWT	23.9
	120-200,000 DWT	23.9
	80-120,000 DWT	24.3
	60-80,000 DWT	26.7
	40-60,000 DWT	27.5
	<40,000 DWT	28.3
	All	26.1
Other tanker	>200,000 DWT	23.9*
	120-200,000 DWT	23.9*
	80-120,000 DWT	24.3*
	60-80,000 DWT	26.7*
	40-60,000 DWT	27.5*
	<40,000 DWT	28.3*
	All	26.1*
Bulk carrier	>80,000 DWT	23.6
	60-80,000 DWT	24.5
	40-60,000 DWT	25.1
	<40,000 DWT	26.6
	All	25.7
Container	>60,000 DWT	24.9*
	40-60,000 DWT	24.9
	20-40,000 DWT	25.4
	<20,000 DWT	25.5
	All	25.4
Gas	>30,000 DWT	28.4
	10-30,000 DWT	31.4
	<10,000 DWT	28.7
	All	29.3
Passenger/ro-ro/vehicle	>10,000 DWT	22.5
	5-10,000 DWT	28.4

	<5,000 DWT	28.6
	All	27.1
Other cargo vessel	>40,000 DWT	26.1
	20-40,000 DWT	24.5
	10-20,000 DWT	25.7
	<10,000 DWT	27.1
	All	25.9
Non-cargo vessel	>40,000 DWT	27.7*
	20-40,000 DWT	27.7*
	10-20,000 DWT	27.7*
	<10,000 DWT	27.7
	All	27.7*

Note: A * indicated that the numbers is not solely based on the mathematical average. Corrections have been for the segments with only few observations

13.4 Appendix 4: Freight rates

The table below shows the average spot freight rates for oil tankers for all routes.

Table 13.5 Average spot freight rates for all routes (percentage of Worldscale)

	MR	LR1	LR2	VLCC	Index
Size range (1,000 DWT)	25.0-44.9	45.0-79.9	80.0-159.9	160.0-319.9	
Weight	25%	25%	25%	25%	
1994	170.7	116.2	85.5	42.3	103.7
1995	171.1	119.0	93.7	55.5	109.8
1996	191.5	128.2	102.8	60.6	120.8
1997	184.9	153.6	103.7	67.9	127.5
1998	154.2	120.4	92.6	63.1	107.6
1999	141.7	114.2	83.8	49.3	97.3
2000	234.8	217.7	164.0	106.9	180.9
2001	209.2	175.9	133.9	74.4	148.4
2002	150.0	129.2	95.6	48.1	105.7

Source: OPEC Annual Statistical Bulletin 2002

Note: Average spot freight rates are the average of all spot freight rates by tanker size reported each month in the spot market

13.5 Appendix 5: Age profiles

The tables below show the age profile of the fleet by DWT and number of vessels.

Table 13.6: Age profile of current fleet (Million DWT and share of fleet)

Segment		0-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25+ years	Total
Other tanker	mDWT	83.7	62.0	24.9	5.7	2.1	2.5	180.9
	%	46.3%	34.3%	13.7%	3.1%	1.2%	1.4%	100.0%
Bulk carrier	mDWT	54.8	72.2	42.4	44.5	55.7	32.1	301.7
	%	18.2%	23.9%	14.0%	14.8%	18.5%	10.6%	100.0%
Container	mDWT	27.5	27.8	13.6	8.8	7.1	4.7	89.4
	%	30.7%	31.1%	15.3%	9.8%	7.9%	5.2%	100.0%
Gas	mDWT	4.3	3.4	3.7	1.1	3.1	4.7	20.3
	%	21.1%	16.9%	18.3%	5.2%	15.4%	23.1%	100.0%
Passenger/ro-ro/vehicle	mDWT	2.3	2.6	1.2	2.5	3.4	3.3	15.5
	%	15.1%	17.1%	8.0%	16.4%	22.0%	21.4%	100.0%
Other cargo vessel	mDWT	5.5	10.5	5.8	7.6	10.5	15.6	55.5
	%	9.9%	19.0%	10.4%	13.7%	18.9%	28.1%	100.0%
Non-cargo vessel	mDWT	0.7	0.6	0.2	0.2	0.3	0.5	2.5
	%	28.1%	26.1%	6.4%	6.9%	13.7%	18.9%	100.0%
Total	**mDWT**	**178.8**	**179.2**	**91.7**	**70.3**	**82.4**	**63.3**	**665.7**
	%	**26.9%**	**26.9%**	**13.8%**	**10.6%**	**12.4%**	**9.5%**	**100.0%**

Table 13.7: Age profile of current fleet (Number of vessels and share of fleet)

Segment		0-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25+ years	Total
Other tanker	No.	926	904	448	162	161	265	2,866
	%	32.3%	31.5%	15.6%	5.7%	5.6%	9.2%	100.0%
Bulk carrier	No.	795	1,093	561	757	1151	1,066	5,423
	%	14.7%	20.2%	10.3%	14.0%	21.2%	19.7%	100.0%
Container	No.	680	1,033	496	300	323	321	3,153
	%	21.6%	32.8%	15.7%	9.5%	10.2%	10.2%	100.0%
Gas	No.	127	170	159	56	137	156	805
	%	15.8%	21.1%	19.8%	7.0%	17.0%	19.4%	100.0%
Passenger/ro-ro/vehicle	No.	163	222	136	221	295	409	1,446
	%	11.3%	15.4%	9.4%	15.3%	20.4%	28.3%	100.0%
Other cargo vessel	No.	447	856	652	647	898	1,98	4,798
	%	9.3%	17.8%	13.6%	13.5%	18.7%	27.1%	100.0%
Non-cargo vessel	No.	189	184	45	53	106	62	639
	%	29.6%	28.8%	7.0%	8.3%	16.6%	9.7%	100.0%
Total	**No.**	**3,327**	**4,462**	**2,497**	**2,196**	**3,071**	**3,577**	**19,130**
	%	**17.4%**	**23.3%**	**13.1%**	**11.5%**	**16.1%**	**18.7%**	**100.0%**

13.6 Appendix 6: The fleet of single hull oil tankers

This appendix includes tables on the existing fleet of single hull tankers.

Table 13.8 The fleet of single hull oil tankers by category, hull type and year of delivery (Million DWT)

Build year	**CAT 1**			**CAT 2**			**CAT 3**			**Total**
	DB/DS	SS	CAT 1 total	DB/DS	SS	CAT 2 total	DB/DS	SS/Missing	CAT 3 total	
Pre 1970	0.1	0.6	0.6	0.0	0.0	0.0	0.0	0.3	0.3	1.0
1970	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.2
1971	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.2	0.4
1972	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.1	0.2	0.4
1973	0.5	0.4	0.9	0.0	0.0	0.0	0.0	0.2	0.2	1.1
1974	0.1	2.1	2.2	0.0	0.0	0.0	0.1	0.3	0.3	2.5

1975	0.2	2.2	2.4	0.0	0.0	0.0	0.1	0.4	0.5	2.9
1976	0.4	5.3	5.7	0.0	0.0	0.0	0.1	0.2	0.3	5.9
1977	0.5	3.1	3.5	0.0	0.0	0.0	0.1	0.2	0.3	3.8
1978	0.8	1.5	2.3	0.0	0.0	0.0	0.1	0.1	0.2	2.5
1979	0.6	4.0	4.6	0.0	0.0	0.0	0.1	0.2	0.3	4.9
1980	0.9	4.3	5.2	0.0	0.0	0.0	0.3	0.3	0.5	5.7
1981	1.8	5.3	7.1	0.0	0.0	0.0	0.2	0.3	0.5	7.6
1982	0.0	0.0	0.0	1.3	3.9	5.2	0.2	0.3	0.5	5.7
1983	0.0	0.0	0.0	1.2	3.2	4.4	0.3	0.2	0.5	4.9
1984	0.0	0.0	0.0	0.7	2.4	3.1	0.3	0.3	0.6	3.7
1985	0.0	0.0	0.0	1.3	2.2	3.5	0.4	0.4	0.7	4.3
1986	0.0	0.0	0.0	1.6	4.4	5.9	0.2	0.2	0.4	6.3
1987	0.0	0.0	0.0	1.5	3.1	4.6	0.1	0.2	0.3	4.8
1988	0.0	0.0	0.0	1.8	4.1	5.9	0.1	0.2	0.3	6.2
1989	0.0	0.0	0.0	1.7	6.2	7.9	0.1	0.2	0.2	8.2
1990	0.0	0.0	0.0	1.1	6.7	7.8	0.1	0.2	0.2	8.0
1991	0.0	0.0	0.0	1.6	7.4	8.9	0.2	0.1	0.3	9.2
1992	0.0	0.0	0.0	1.8	8.5	10.3	0.0	0.1	0.2	10.5
1993	0.0	0.0	0.0	1.4	7.2	8.5	0.1	0.2	0.3	8.8
1994	0.0	0.0	0.0	0.1	5.0	5.1	0.0	0.1	0.1	5.3
1995	0.0	0.0	0.0	0.1	3.8	3.9	0.0	0.1	0.1	4.0
1996	0.0	0.0	0.0	0.0	0.4	0.4	0.0	0.0	0.1	0.5
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**5.7**	**29.3**	**35.0**	**17.2**	**68.6**	**85.7**	**3.2**	**5.6**	**8.8**	**129.5**

Note: 2003 includes only January - September

Table 13.9 The fleet of single hull oil tankers by category, hull type and year of delivery (Number of vessels)

Build year	**CAT 1**			**CAT 2**			**CAT 3**			**Total**
	DB/DS	SS	CAT 1 total	DB/DS	SS	CAT 2 total	DB/DS	SS/Missing	CAT 3 total	
Pre 1970	2	17	19	0	0	0	2	36	38	57
1970	0	3	3	0	0	0	2	8	10	13
1971	1	4	5	0	0	0	1	27	28	33
1972	0	5	5	0	0	0	3	17	20	25
1973	5	11	16	0	0	0	7	22	29	45
1974	2	26	28	0	0	0	8	28	36	64

1975	6	39	45	0	0	0	14	31	45	90
1976	12	64	76	0	0	0	8	20	28	104
1977	10	44	54	0	0	0	9	16	25	79
1978	14	29	43	0	0	0	9	15	24	67
1979	9	35	44	0	0	0	13	20	33	77
1980	17	57	74	0	0	0	31	25	56	130
1981	38	73	111	0	0	0	25	26	51	162
1982	0	0	0	32	71	103	20	23	43	146
1983	0	0	0	26	50	76	30	23	53	129
1984	0	0	0	18	35	53	31	29	60	113
1985	0	0	0	21	33	54	36	39	75	129
1986	0	0	0	24	40	64	19	17	36	100
1987	0	0	0	22	30	52	10	16	26	78
1988	0	0	0	23	35	58	14	17	31	89
1989	0	0	0	21	38	59	9	19	28	87
1990	0	0	0	17	48	65	8	19	27	92
1991	0	0	0	18	44	62	16	19	35	97
1992	0	0	0	17	43	60	6	19	25	85
1993	0	0	0	10	39	49	7	27	34	83
1994	0	0	0	3	21	24	0	16	16	40
1995	0	0	0	2	17	19	3	7	10	29
1996	0	0	0	0	5	5	2	4	6	11
1997	0	0	0	0	1	1	0	1	1	2
1998	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0
Total	116	407	523	254	550	804	343	586	929	2,256

13.7 Appendix 7: Future scrapping volumes

This appendix includes tables on future scrapping volumes.

13.7.1 Base scenario

Table 13.10: Oil tanker phase out by IMO category, hull type and year of phase out - Base scenario (Number of vessels)

Phase out year	**CAT 1**			**CAT 2**			**CAT 3**			**To-tal**	**Av. age at scrap**
	DB/DS	SS	CAT 1 total	DB/DS	SS	CAT 2 total	DB/DS	SS/Missing	CAT 3 total		

2003	8	40	48	0	0	0	15	110	125	173	33.3
2004	8	65	73	0	0	0	22	59	81	154	29.4
2005	22	108	130	0	0	0	17	36	53	183	28.6
2006	40	121	161	0	0	0	22	35	57	218	27.0
2007	38	73	111	0	0	0	56	51	107	218	26.3
2008	0	0	0	32	71	103	20	23	43	146	26.0
2009	0	0	0	26	50	76	30	23	53	129	26.0
2010	0	0	0	18	35	53	31	29	60	113	26.0
2011	0	0	0	21	33	54	36	39	75	129	26.0
2012	0	0	0	24	40	64	19	17	36	100	26.0
2013	0	0	0	22	30	52	10	16	26	78	26.0
2014	0	0	0	23	35	58	14	17	31	89	26.0
2015	0	0	0	38	256	294	17	131	148	442	23.6
2016	0	0	0	18	0	18	16	0	16	34	25.0
2017	0	0	0	17	0	17	6	0	6	23	25.0
2018	0	0	0	10	0	10	7	0	7	17	25.0
2019	0	0	0	3	0	3	0	0	0	3	25.0
2020	0	0	0	2	0	2	3	0	3	5	25.0
2021	0	0	0	0	0	0	2	0	2	2	25.0
Total	**116**	**407**	**523**	**254**	**550**	**804**	**343**	**586**	**929**	**2256**	**26.6**

Table 13.11: Oil tanker phase out by IMO category, hull type and year of phase out - Base scenario (Million DWT)

Phase out year	**CAT 1**			**CAT 2**			**CAT 3**			**Total**
	DB/DS	SS	CAT 1 total	DB/DS	SS	CAT 2 total	DB/DS	SS/Missing	CAT 3 total	
2003	0.6	1.5	2.0	0.0	0.0	0.0	0.1	1.0	1.1	3.1
2004	0.3	4.3	4.6	0.0	0.0	0.0	0.2	0.6	0.8	5.4
2005	0.8	8.4	9.2	0.0	0.0	0.0	0.1	0.4	0.5	9.7
2006	2.3	9.8	12.1	0.0	0.0	0.0	0.2	0.4	0.5	12.6
2007	1.8	5.3	7.1	0.0	0.0	0.0	0.5	0.5	1.0	8.2
2008	0.0	0.0	0.0	1.3	3.9	5.2	0.2	0.3	0.5	5.7
2009	0.0	0.0	0.0	1.2	3.2	4.4	0.3	0.2	0.5	4.9
2010	0.0	0.0	0.0	0.7	2.4	3.1	0.3	0.3	0.6	3.7
2011	0.0	0.0	0.0	1.3	2.2	3.5	0.4	0.4	0.7	4.3
2012	0.0	0.0	0.0	1.6	4.4	5.9	0.2	0.2	0.4	6.3
2013	0.0	0.0	0.0	1.5	3.1	4.6	0.1	0.2	0.3	4.8
2014	0.0	0.0	0.0	1.8	4.1	5.9	0.1	0.2	0.3	6.2
2015	0.0	0.0	0.0	2.8	45.2	48.1	0.2	1.1	1.2	49.3
2016	0.0	0.0	0.0	1.6	0.0	1.6	0.2	0.0	0.2	1.7
2017	0.0	0.0	0.0	1.8	0.0	1.8	0.0	0.0	0.0	1.9
2018	0.0	0.0	0.0	1.4	0.0	1.4	0.1	0.0	0.1	1.4
2019	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1
2020	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.2

2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**5.7**	**29.3**	**35.0**	**17.2**	**68.6**	**85.7**	**3.2**	**5.6**	**8.8**	**129.5**

13.7.2 Accelerated phase out scenario

Table 13.12: Oil tanker phase out by IMO category, hull type and year of phase out - Accelerated phase out scenario (Number of vessels)

Phase out year	**CAT 1**			**CAT 2**			**CAT 3**			**Total**	**Av. age at scrap**
	DB/DS	SS	CAT 1 total	DB/DS	SS	CAT 2 total	DB/DS	SS/Missing	CAT 3 total		
2003	78	334	412	0	0	0	37	169	206	618	28.2
2004	38	73	111	0	0	0	8	20	28	139	24.0
2005	0	0	0	0	0	0	9	16	25	25	28.0
2006	0	0	0	0	0	0	22	35	57	57	27.4
2007	0	0	0	0	0	0	56	51	107	107	26.5
2008	0	0	0	32	71	103	20	23	43	146	26.0
2009	0	0	0	26	50	76	30	23	53	129	26.0
2010	0	0	0	39	429	468	67	249	316	784	21.4
2011	0	0	0	24	0	24	19	0	19	43	25.0
2012	0	0	0	22	0	22	10	0	10	32	25.0
2013	0	0	0	23	0	23	14	0	14	37	25.0
2014	0	0	0	21	0	21	9	0	9	30	25.0
2015	0	0	0	67	0	67	42	0	42	109	23.3
Total	**116**	**407**	**523**	**254**	**550**	**804**	**343**	**586**	**929**	**2256**	**24.8**

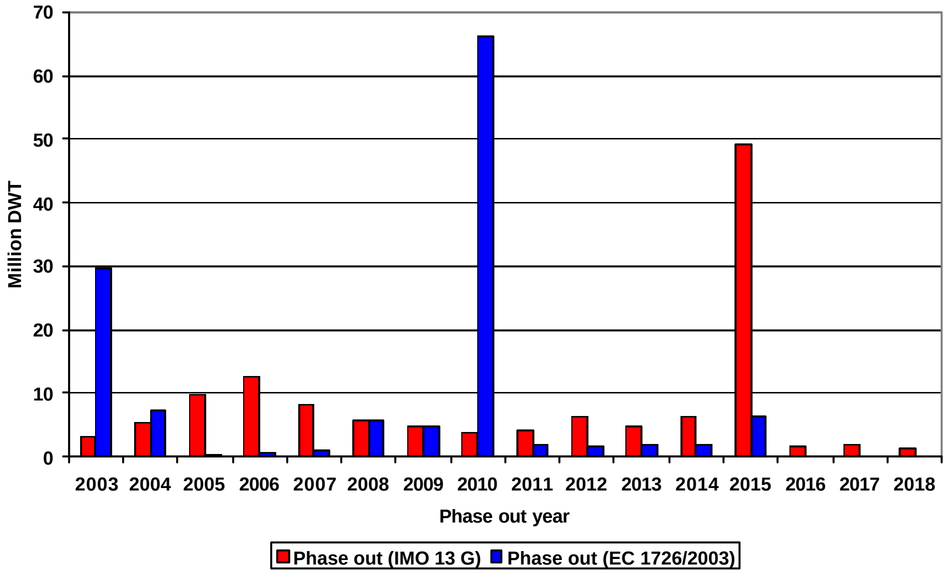
Table 13.13: Oil tanker phase out by IMO category, hull type and year of phase out - Accelerated phase out scenario (Million DWT)

Phase out year	**CAT 1**			**CAT 2**			**CAT 3**			**Total**
	DB/DS	SS	CAT 1 total	DB/DS	SS	CAT 2 total	DB/DS	SS/Missing	CAT 3 total	
2003	3.9	23.9	27.9	0.0	0.0	0.0	0.3	1.6	1.9	29.7
2004	1.8	5.3	7.1	0.0	0.0	0.0	0.1	0.2	0.3	7.4
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.5	0.5
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	1.0	1.0
2008	0.0	0.0	0.0	1.3	3.9	5.2	0.2	0.3	0.5	5.7
2009	0.0	0.0	0.0	1.2	3.2	4.4	0.3	0.2	0.5	4.9
2010	0.0	0.0	0.0	2.0	61.4	63.5	0.7	2.2	2.9	66.3
2011	0.0	0.0	0.0	1.6	0.0	1.6	0.2	0.0	0.2	1.8

2012	0.0	0.0	0.0	1.5	0.0	1.5	0.1	0.0	0.1	1.6
2013	0.0	0.0	0.0	1.8	0.0	1.8	0.1	0.0	0.1	1.9
2014	0.0	0.0	0.0	1.7	0.0	1.7	0.1	0.0	0.1	1.8
2015	0.0	0.0	0.0	6.1	0.0	6.1	0.4	0.0	0.4	6.5
Total	**5.7**	**29.3**	**35.0**	**17.2**	**68.6**	**85.7**	**3.2**	**5.6**	**8.8**	**129.5**

13.7.3 Comparison of phase out scenarios

Figure 13.1: Comparison of phase out schemes (million DWT) (Single hull oil tankers)



13.8 Appendix 8: Oil trade

The table below shows oil imports in 2002 by regions.

Table 13.14 Oil imports 2002 (Million tonnes)

Region	Crude imports	Product imports	Total	Share of world total
USA	450.5	110.5	561.0	26.06%
Canada	43.2	8.3	51.5	2.39%
Mexico	-	11.6	11.6	0.54%
South & Central America	42.2	12.7	54.9	2.55%
Europe	467.4	120.0	587.4	27.29%

Baltic & Black Seas	-	5.5	5.5	0.26%
Middle East	4.2	5.1	9.3	0.43%
North Africa	8.3	6.0	14.3	0.66%
West Africa	2.9	8.3	11.2	0.52%
East & Southern Africa	24.7	5.3	30.0	1.39%
Australasia	24.5	5.2	29.7	1.38%
China	69.4	31.0	100.4	4.66%
Japan	202.2	48.3	250.5	11.64%
Other Asia Pacific	327.2	98.1	425.3	19.76%
Unidentified	-	10.0	10.0	0.46%
World total	**1666.7**	**485.9**	**2152.6**	**100%**

Source: IMO MEPC 50/INF.4 / BP 2003 Statistical Review of World Energy
Note: Intra-area movements (for example between countries in Europe are excluded)

13.9 Appendix 9: Identified docks of >60,000 DWT outside Europe

Existing dry-docks outside Europa with a capacity above 60,000 DWT

South America				
Brazil	IVI - Ishibras	Rio de Janeiro	350 x 65	400,000
Chile	Asmar Chile	Talcahuano	251 x 34	95,000
Mexico	Auver	Veracruz	271 x 36	80,000
North America				
Canada	Saint John SB	Saint John	427 x 38	80,000
United States	Beth. Ship	Baltimore	365 x 59	300,000
United States	Kvaerner	Philadelphia	332 x 45	150,000
United States	National Steel	San Diego	303 x 52	250,000
United States	Newport News Shipbuilding	Newport News	487 x 76	400,000
Asia				
China	Dalian New Shipyard	Dalian	308 x 50 365 x 80	150,000 400,000
China	Pudong Shipyard	Shanghai	460 x 106 360 x 76	VLCC
China	Jiangnan Shipyard	Shanghai	275 x 40	70,000
India	Cochin Shipyards Ltd.	Cochin	255 x 43	86,000
Indonesia	P.T. Pal Indonesia	Surabaya	300 x 32 230 x 26	370,000

Japan	Hitachi Zosen, Ariake Works	Nagasu	595 x 82	300,000
Japan	Imabari Zosen, Marugane Yard	Marugane	270 x 45 290 x 57	80,000
Japan	Ishikawajima-Harima H.I.	Kure	334 x 65 508 x 80	370,000 800,000
Japan	Ishikawajima-Harima H.I.	Chita, Aichi	353 x 46	300,000
Japan	Koyo Dockyard	Mihara	378 x 59	300,000
Japan	Mitsubishi H.I.	Nagasaki	304 x 51 223 x 38	300,000 225,000
Japan	Naikai Zosen Corp.	Setoda	220 x 35	70,000
Japan	Namura Zosensho	Imari	432 x 67	100,000
Japan	Nippon Kokan	Tsu	500 x 75	500,000
Japan	Onomichi Zosen	Onomichi	254 x 40	106,000
Japan	Sasebo H.I.	Sasebo	400 x 57	380,000
Japan	Shin Kurushima D.Y.	Onishi	311 x 47	150,000
Japan	Sumitomo	Yokosuka	537 x 77	700,000
South Korea	Daedong SB	Chinhae	320 x 74	250,000
South Korea	Daewoo HI	Okpo, Koje	530 x 131 350 x 81	1,000,000 350,000
South Korea	Halla Eng & HI	Samho	515 x 100 524 x 70	900,000 500,000
South Korea	Hanjin HI	Youngdo, Pusan	301 x 50	150,000
South Korea	Hanpo	Pusan	8 docks > 260 x 43	150,000 - 1,000,000
South Korea	Hyundai Mipo Works	Ulsan	380 x 65	400,000
South Korea	Samsung SB & HI	Kohyun, Koje	283 x 46 390 x 65 640 x 98	200,000 400,000 1,000,000
Philippines	Tsuneishi	Cebu	"Panamax"	73,000
Taiwan	China SB	Kaoshiung	950 x 92	1,000,000
Taiwan	China SB	Keelung	275 x 45	149,000
Vietnam	Hyundai - Vinashin	Khanh Hoa	380 x 65	400,000