European Commission DG Environment

Support to the impact assessment of a new legislative proposal on ship dismantling

Final report

December 2009

COWI

COWI A/S

Parallelvej 2
DK-2800 Kongens Lyngby
Denmark

Tel +45 45 97 22 11
Fax +45 45 97 22 12
www.cowi.com

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Executive summary

Introduction

This is executive summary of the final report on the study to support the Commission's impact assessment of a new legislative proposal on ship dismantling made under Study Contract No. 07.0307/2009/539107/G4. The study is carried out by COWI A/S with input from LITEHAUZ ApS. The Study commenced in August 2009 and finalised in December 2009.

Study objective and context

The objective of the study is to provide as far as possible quantitative information to the Commission services on the potential impacts (environmental, social and economic) of two scenarios for implementation of the Hong Kong International Convention on the Safe and Environmentally Sound Recycling of Ships (The Hong Kong Convention, HKC):

1 **Scenario 1: The baseline scenario** (No additional action at EU level). Under this scenario no policy change at EU level is envisaged. Upgraded beaching is considered as compliant with the Hong Kong Convention in the baseline scenario. It is assumed that the Hong Kong Convention is ratified by a sufficient number of flag and recycling states and enters into force in 2020. The following variants are also addressed:

- The Convention enters into force in 2015
- The Convention enters into force in 2025
- The Convention would not enter into force

The Hong Kong Convention's guidelines describing what is considered as a safe and environmentally sound ship recycling are still being developed. In addition, there are diverging views regarding the possibility for beaching to be considered as compliant with the Hong Kong Convention. Therefore as a sub scenario 1a) have also been analysed the implications of a situation were upgraded beaching would not be considered as compliant (strict interpretation of the Convention).

2 **Scenario 2: The reinforced scenario.** Under this scenario, the EU foresees to progressively increase i) the control on ships going for dismantling also targeting “ships at risk" and ii) the requirements for the acceptable methods for ship dismantling in order to meet in the mid term EU equivalent standards. This could happen either through a reinforcement of existing legislation or with a specific legislation to implement the Hong Kong Convention. The impact of extending the scope to warships and government vessels is also assessed. The EU measure would be proposed and applicable by 2014 at the latest.

The two scenarios including sub-scenarios and variants have been chosen to represent various options for better ship dismantling, which will ensure that ships with a strong link to the EU are dismantled only in safe and environmentally sound facilities worldwide.

The Study is closely linked to and draws on several of the other Commission studies which have been launched to bring together data and information to facilitate the Commission’s decisions making on the policy options to be further pursued. It is a follow up study to the COWI/Milieu study in relation to options for new initiatives regarding dismantling of ships, which inter alia reviewed the pros and cons of early EU transposition of the Hong Kong Convention on Ship Recycling and envisaged the implications of transposition of the Convention’s key elements.

The study ran in parallel to another Commission study on so-called "at risk" ships, which are ships that could be recycled within a near future. This study was performed by Bio Intelligence Service (Bio), who provided information[1] forming basis for that specific part of this study.

Methodology and data collection

Introduction

The team has liaised closely with desk officers in DG ENV and experts of the European Maritime Safety Agency (EMSA). Further, a number of representatives of industry, national and international authorities and other stakeholders have been interviewed and contributed information to the study.

Main base data set

In general, the methodology applied includes establishment of a main base data set, which was used for the subsequent analyses of impacts of the different scenarios and sub-scenarios applying the base data set to a dedicated Excel model developed for the study. By this the predicted future amounts of and locations for scrapping of European vessels are compared to for instance the predicted

[1] Note: Ship_Dismantling_Forecasts_BIO.doc received in e-mail dated 6 November 2009 from Mary Ann Kong

outputs of hazardous waste per unit recycled ship to predict the amount of hazardous waste generated from scrapping of EU vessels within that scrapping location. Time steps for the model are each five years within the time period 2000 - 2030.

The main base data set is presented below.

Future scrapping of European Vessels: amounts and locations

An important input for the analyses is the expected future scrapping, in terms of volumes and locations, of European Vessels. The projections have been established based on the most recent public data set on ship dismantling available from DG ENV as reported by COWI/DHI in a 2007 report[2]. These data have been supplemented with information from EMSA on the most recent scrapping volumes. Furthermore, the COWI/DHI projection have been extended (to 2030) using estimates of the expected increase in sea freight volumes.

The table below shows the historical and future predicted volumes of demolition by owner/flag State, as applied in the study.

Table 0-1 Historical and future volumes of demolition by owner/flag State and year of scrap (Million LDT). EU flagged vessels applied in the analyses

Mill. LDT per year	2000	2005	2010	2015	2020	2025	2030
In total	4.90	1.60	17.90	6.40	6.50	7.25	8.82
hereof							
EU flagged and owned	0.90	0.29	2.40	1.20	1.50	1.33	1.62
EU owned, not EU flagged	0.96	0.31	3.10	1.30	1.20	1.42	1.72
EU flagged, not EU owned	0.14	0.05	0.30	0.30	0.20	0.21	0.26
Not EU flagged, not EU own.	2.90	0.95	12.00	3.70	3.60	4.30	5.23

One of the policy options identified by the Commission includes the policy measure of targeting ships which are calling EU ports and which are identified to be "at risk" for being recycled within a near future. Making rough assumptions about the world fleet being uniform in terms of size and sail patterns, the EU policy option, which is targeting both recycling of EU-flagged ships and all "at risk" ships visiting EU ports, will have an outreach, which is double, in terms of weight, that of a policy option only targeting EU-flagged ships (the amounts presented in the table above).

The projections for the locations of future scrapings have been established based on the most recent public data set on ship dismantling available from DG ENV via EMSA. For the projections the recycling locations are grouped according to the recycling methods applied and geography.

[2] COWI/DHI/DG ENV: 'Ship Dismantling and Pre-cleaning of Ships' (2007)

Table 0-2 Recycling locations in terms of percentage of total recycling (GT based) in 2009. Percentages applied for the analyses

Recycling location	Method	Recycling fraction of total, %
India, Bangladesh and Pakistan	Beaching	71,79
China	Afloat	22,22
OECD non-EU	Landing, afloat and unspecific: Landing in analyses	5,05
EU (of this UK)	Slipway (docking)	0,95 (0,06)
Total		100

Recyclable materials output

The base data set on recyclable materials output from recycling of ships, split between merchant and navy ships, are presented below. The data set for merchant vessels are primarily based on data from the 1999 Norwegian study[3] supplemented with on oily sludge provided by the Divest project in Turkey. Data for navy vessels are based on data from the French aircraft carrier "Clemenceau" [4] supplemented with the merchant vessel data for Cu, non-ferrous and heavy metals, TBT and ODS.

		Merchant ship	Navy ship
Tonnage (LDT)		37.500	31.400
Recyclable metals			
Steel	Tons	27.750	23.236
Copper	Tons	3,75	3,14
Non-ferrous metals	Tons	3.000	2.512
Hazardous substances			
Asbestos	Tons	7,00	771
PCB	kg	0,01	122.000
Heavy metals	Tons	0,26	0,22
Oil	Tons	315	35
Oil sludges	Tons	375	312
Tri butyl tin	Tons	1,20	1,00
Mercury	kg	0,02	2.000
Ozone Depleting Substances	Tons	0,90	0,75

[3] Norwegian Ministry of the Environment, 1999. Decommissioning of Ships. Environmental Protection and Ship Demolition Practices. Norwegian Ministry of the Environment and Norwegian Shipowners Association. Technical Report. Report No 99-3065 Revision No. 03.

[4] Notification for Clemanceau as provided by DG ENV

Health, Safety and Environment

In general it is very difficult to obtain quantitative information on the health, safety and environmental performance and impacts of ship recycling. In general these data are not collected and/or not publicly available.

Different information sources have however reported data, e.g. on the number of fatal and non-fatal accidents. These existing information have been combined with additional data obtained as part of this study and with theoretical health and safety benchmarks as described in the EMSA Triple-A system[5] to establish the health, safety and environment base data set applied in the assessments. In general the EMSA Triple-A system on different compliance levels for the various recycling techniques and geographies are applied as seen in the following table presenting part of the health, safety and environment base data set.

		AAA EU	AA EU	AA China etc.	A Turkey	A Upgraded India	Substandard India	A Upgraded Pakistan and Bangladesh	Substandard Bangladesh, Pakistan
Labour									
Workers needed per 100.000 LDT	Nb	73	73	138	138	455	455	455	455
of which protected workers	%	100	100	100	100	100	100	100	50
not protected workers	%	0	0	0	0	0	0	0	50
children	%	0	0	0	0	0	0	0	17
Accident									
Adults life	Nb of persons/100000 man-years	13	13	26	39	39	39	39	112,88
Adults - non-fatal accidents	Nb of persons/100000 man-years	6000	6000	12000	18000	18000	18000	18000	31450
Children - life	Nb of persons	0	0	0	0	0	0	0	23,12
Children - non-fatal accidents	Nb of persons	0	0	0	0	0	0	0	5347
Hazardous substances									
Asbestos	% not according to ESM	0	0	0	0	0,125	0,75	0,75	1
	% according to ESM	1	1	1	1	0,875	0,25	0,25	0
PCB	% not according to ESM	0	0	0	0	0,5	1	0,75	1
	% according to ESM	1	1	1	1	0,5	0	0,25	0
Heavy metals	% not according to ESM	0	0	0	0	0,25	0,25	0,25	0,25
	% according to ESM	1	1	1	1	0,75	0,75	0,75	0,75
Oil	% not according to ESM	0	0	0	0	0	0	0	0
	% according to ESM	1	1	1	1	1	1	1	1
Oil sludges	% not according to ESM	0	0	0	0	0,125	0,5	0,375	0,5
	% according to ESM	1	1	1	1	0,875	0,5	0,625	0,5
Tri butyl tin	% not according to ESM	0	0	0	0	1	1	1	1
	% according to ESM	1	1	1	1	0	0	0	0
Mercury	% not according to ESM	0	0	0	0	0,125	1	0,75	1
	% according to ESM	1	1	1	1	0,875	0	0,25	0
Ozone Depleting substances	% not according to ESM	0	0	0	0	0,5	1	0,8125	1
	% according to ESM	1	1	1	1	0,5	0	0,1875	0

Economics

The economic base data set includes unit costs, e.g. per ship, per death etc. The main costs identified and included in the economic analyses are the following:

Costs for ships in operation:

- Establishing Inventory of Hazardous Materials (IHM)
- Issuing and checking of certificates based on the IHM

[5] See the 2008 COWI/Litehauz study for EMSA

- Port state control of certificates for ships calling EU ports
- Flag-state control for EU Member State flags
- Checking of IHM certificates for ships calling European ports.

Costs for preparing ships for recycling:

- Update of the IHM's
- Issuing and checking of the Ready to recycle certificates
- Issuing and checking of ship recycling plans from EU recycling facilities
- Costs (loss of net revenue) for selling a ship for recycling at a facility with a certain minimum HSE standard.

Costs for EU recycling facilities:

- Preparation and issuing of ship recycling facility management plan and emergency preparedness and response plans for EU ship recycling facilities
- Authorisation of EU ship recycling facilities
- Issuing and checking of Statement of completion.

The unit costs are based on the time spent on these tasks as described in an assessment for Denmark[6] and the cost for analysis. These estimates are then scaled up to a European level through applying the relevant labour costs and number of ships.

Reflagging

One very important issue when analysing impacts of new legislation targeting the shipping industry is the flag state regime, which allows the ship owners to change flag and by the same change the legal regime for the ship. This is especially important when evaluating a regional regulatory approach like scenario 2.

For scenario 1 it is also relevant to address the reflagging issue, as the ratification and transposition of the Hong Kong Convention by EU Member States here is likely to take place at different pace. EU flagged ships could thus have an incentive to change flag to another EU Member State not (yet) Party to the Convention or to non EU flag states[7].

The reflagging issue have been analysed for both scenarios in the study and indications of a significant ongoing reflagging also of EU vessels have been pre-

[6] Memo on Socio economic impact assessment of IMO Ship Recycling Convention implementation in Denmark. Prepared by Litehauz for the Danish Environmental Protection Agency

[7] In this context, it may be noted that the cost for a ship to change flag is approximately EUR 7000, and therefore as indicated by several stakeholders at the stakeholder workshop held on 23 October 2009 in Brussels, would be a minor cost for the ship owner.

sented including indications of ongoing in-flagging of vessels for recycling to some EU member states.

To get an idea of the possible extra size of an EU re-flagging resulting from the regional policy option like scenario 2, a brief assessment is performed within the study on the potential re-flagging seen in 2003 around the time of introducing the EC Regulation 782/2003 on the prohibition of fresh application of TBT antifouling paints on EU-flagged. Even though highly indicative the analysis indicate a potential reflagging of around 1/3 of the EU-flagged fleet resulting from this introduction of regional environmental guidelines.

Reflagging is not included directly quantitatively in the impact analyses of the study.

Results of analyses

Baseline scenario - No additional action at EU level

General

Taking no early or additional action at EU level would mean, that the current trends in ship dismantling would continue unabated, until the HKC is ratified by Member States and enters into force in 2020.

After transposition of the IMO HKC into the national law of flag States and recycling States in 2020, positive effects are expected in a step by step process as a result of entry into force of the different requirements of the HKC, e.g. the obligation to carry an Inventory of Hazardous Materials (IHM), the requirement for ship recycling facilities to be authorised etc.

The requirement for ship recycling facilities to obtain a permit from the competent authority is already covered under national legislation in EU 27 transposing Community legislation. A recycling facility management plan does not however exist as a legal obligation under existing national or Community law. As strict requirements for water protection and waste management are already in place for recycling facilities in EU 27, transposition of the specific Convention requirement would not substantially alter the environmental conditions for these facilities in the EU.

The new elements of the Convention for operators, including the Recycling Facility Management Plan, could improve compliance of an operator with environmental and safety rules, as it is supposed to be ship specific and be based on details on the specific hazards related to recycling of that ship, e.g. IHM data as incorporated in the Ship Recycling Plan. The exact content of the Recycling Facility Management Plan is still being developed in the Convention guidelines.8

[8] Guidelines for the Safe and Environmentally Sound Ship Recycling

Environmental

Below is shown the estimated amount of materials generated from recycling of EU-ships in the period 2000 - 2030.

Table 0-3 Amounts of recyclable materials generated from recycling of merchant EU-ships

Recyclable metals	Units	2000	2005	2010	2015	2020	2025	2030
Steel	Tons	743.718	222.912	1.968.400	1.080.400	1.228.400	1.114.792	1.362.728
Copper	Tons	101	30	266	146	166	151	184
Non-ferrous metals	Tons	80.402	24.099	212.800	116.800	132.800	120.518	147.322

None of the metals are generated in EU as all vessels are, in the context of scenario 1, assumed recycled outside Europe, given that the scenario exempt from its scope small vessels and government owned vessels, including warships, which are the only vessels currently being recycled in Europe. Government owned vessels including warships are included in scenario 2.

In the Table below is seen the estimated amount of hazardous materials generated as a result of recycling of EU-ships. The total amount of materials is split between the amounts managed according to and not according to accepted environmental sound management procedures in EU.

Table 0-4 Amounts of hazardous materials generated from recycling of EU-ships split between amounts managed according to and not according to EU accepted environmental sound management (ESM) procedures

Hazardous substances	Units	2000	2005	2010	2015	2020	2025	2030
Asbestos	t not according to ESM	120,54	36,13	319,04	175,11	108,45	73,81	60,15
	t according to ESM	67,06	20,10	177,49	97,42	201,42	137,09	111,72
PCB	kg not according to ESM	0,27	0,08	0,61	0,27	0,16	0,10	0,08
	kg according to ESM	0,11	0,03	0,24	0,11	0,18	0,12	0,09
Heavy metals	t not according to ESM	1,25	0,38	3,32	1,82	2,07	1,88	2,30
	t according to ESM	5,73	1,72	15,16	8,32	9,46	8,58	10,49
Oil	t not according to ESM	-	-	-	-	-	-	-
	t according to ESM	8.452	2.533	22.369	12.278	13.959	12.668	15.486
Oil sludges	t not according to ESM	14.883	4.461	39.390	21.620	13.274	12.047	14.726
	t according to ESM	26.578	7.966	70.344	38.610	55.206	50.101	61.243
Tri butyl tin	t not according to ESM	23,09	5,88	42,78	18,45	15,25	8,65	4,23
	t according to ESM	9,07	2,31	16,81	7,25	5,99	3,40	1,66
Mercury	kg not according to ESM	0,29	0,09	0,76	0,42	0,23	0,21	0,26
	kg according to ESM	0,11	0,03	0,30	0,16	0,43	0,39	0,48
Ozone Depleting Substances	t not according to ESM	17,32	5,19	43,54	22,64	11,69	5,30	-
	t according to ESM	6,80	2,04	17,11	8,90	12,21	5,54	-
Total	not according to ESM	15.045	4.508	39.799	21.838	13.412	12.136	14.792
Total	according to ESM	35.118	10.525	92.939	51.009	69.395	62.924	76.853

Other environmental impacts from recycling of EU vessels include atmospheric emissions of CO_2 and other pollutants resulting from both the actual dismantling process and from the following energy consumption for reprocessing the metals generated from the recycling process.

The following table shows the calculated CO_2-emissions from recycling of the steel generated from recycling of the EU-flagged vessels. The "savings" in CO_2-emissions from generation of steel from scrap steel compared to from virgin material are also presented in the table.

Table 0-5 CO2-emissions (1000 tons) from recycling of steel generated from EU-flagged vessels including the "savings" in CO2-emissions stemming from use of scrap instead of metal ore for generation of steel

	2000	2005	2010	2015	2020	2025	2030
Direct emissions (1,000 tons)	761	228	2.014	1.105	1.257	1.140	1.394
Savings from use of scrap metal compared to virgin material	474	142	1.254	688	782	710	868

The pollution of water, soil and habitats in South Asia would remain unchanged and increase when peaks of ship scrapping due to the phasing out of single hull oil tankers reach the South Asian beaches, probably around 2010 and 2015, as the baseline scenario measures do no not enter into force before after this point in time.

Social

The estimated workload (man-years) of respectively adults and children involved in recycling of EU-flagged ships and estimated resulting numbers of fatalities and non-fatal accidents amongst these are shown in the following tables.

Table 0-6 Workload (man-years) of adults involved in recycling of EU-flagged ships including numbers of fatalities and incident amongst these

	2000	2005	2010	2015	2020	2025	2030
Adult workers, man-years	3.110	932	8.231	4.518	6.058	5.498	6.721
Deaths, No.	3	1	8	4	2	2	3
Non-fatal injuries, No.	926	278	2.451	1.345	1.106	1.004	1.227

Table 0-7 Children[9] (man-years) involved in recycling of EU-flagged ships including numbers of fatalities and incident amongst these

	2000	2005	2010	2015	2020	2025	2030
Child workers, man-years	558	167	1.477	811	0	0	0
Fatalities, No.	0	0	1	1	0	0	0
Non-fatal injuries, No.	102	31	269	148	0	0	0

Economic impacts
Estimated costs related to implementation of the Hong Kong Convention requirements are represented in the table below for the baseline scenario. Distinctions have been made between costs on the ships owners and those which fall on the public authorities.

Table 0-8 Cost and revenues for the ship owners in €

	2000	2005	2010	2015	2020	2025	2030
Costs							
Inventories new ships	-	-	-	-	465.195	513.636	763.902
Inventories existing ships	-	-	-	-	-	106.690.059	2.220.031
Certificates	-	-	-	-	751.430	52.095.411	11.728.464
Ready for recycling certificate	-	-	-	-	1.009.243	2.020.865	3.005.517
Costs for checking certificates	-	-	-	-	417.229	1.015.293	1.235.259
Revenues							
Selling ships for recycling	144.064.333	52.534.947	564.410.650	376.906.056	510.178.469	563.303.925	837.769.918
Total (+/-)	**144.064.333**	**52.534.947**	**564.410.650**	**376.906.056**	**507.535.372**	**400.968.662**	**818.816.746**

Table 0-9 Administrative cost for Member states authorities in €

	2000	2005	2010	2015	2020	2025	2030
Additional controls in the Ports	-	-	-	-	19.112	906.816	1.300.974
Certificates	-	-	-	-	417.229	507.623	617.601
total	**-**	**-**	**-**	**-**	**436.341**	**1.414.439**	**1.918.575**

[9] Assuming similar incident rates for children and adults

Table 0-10 Social costs in € - accidents and deaths

	2000	2005	2010	2015	2020	2025	2030
Total	3.317.854	994.449	8.781.378	4.819.854	2.460.703	2.233.125	2.729.784

Comparative impact analysis of scenario 1 and 2 – key figures

Similar analyses is included in the study for the sub-scenarios and variants under scenario 1 and for the scenario 2 including variations. The scope of scenario 2 is in several ways wider than for the baseline scenario, as it includes Member States navy and government owned vessels. Therefore for instance the produced amount of recyclable materials from EU-ships covered by the scenario 2 will be larger than from the baseline scenario.

Below is presented examples of comparative impact analysis of the different policy (sub-)scenarios and variants compared to the baseline. The results are presented in Tables and Figures.

Environmental impacts

The following table includes results of the analyses of hazardous waste treatment compared to the baseline scenario.

Table 0-11 Extra amount of hazardous waste treated according to ESM procedures compared to the 2020 baseline. Note: the total volume of hazardous waste generated in the two maximum scenarios are larger than in the other scenarios resulting from the larger scope for these two maximum scenarios. Therefore the maximum at risk scenario is compared to twice the baseline two counter for the extra number of "at risk" ships.

	2000	2005	2010	2015	2020	2025	2030
Baseline	35.118	10.525	92.939	51.009	69.395	62.924	76.853
Strict baseline	0	0	0	0	13.412	12.136	14.792
2015 implementation	0	0	0	10.032	0	0	0
2025 implementation	0	0	0	0	-11.404	0	0
Current practise	0	0	0	0	-11.404	-10.326	-12.594
Maximum (excl at risk)	1.594	1.556	1.658	11.443	14.571	13.125	15.551
Maximum (incl at risk)	1.585	1.584	1.561	21.602	28.337	25.517	30.560

The results of the analyses of the metal generation in EU and outside EU for scenario 1 (baseline including sub-scenarios) and scenario 2 are shown in the following table. Inclusion of navy ships and other government owned vessels in scenario 2 introduce a risk these being shifted from current recycling in EU to recycling outside EU (not shown in table).

Table 0-12 Metal waste being generated from recycling of EU vessels

		2000	2005	2010	2015	2020	2025	2030
Scenario 1*	EU	7.028	2.107	18.601	10.210	11.608	10.535	12.878
	Non-EU	736.689	220.805	1.949.799	1.070.190	1.216.792	1.104.257	1.349.850
	Total	743.718	222.912	1.968.400	1.080.400	1.228.400	1.114.792	1.362.728
Maximum (excl at risk)	EU	38.125	35.907	48.951	40.959	42.143	41.198	43.441
	Non-EU	736.410	220.526	1.949.519	1.069.911	1.216.512	1.103.977	1.349.570
	Total	774.534	256.433	1.998.470	1.110.870	1.258.655	1.145.175	1.393.011
Maximum (incl at risk)	EU	45.394	38.306	67.732	51.393	54.094	52.070	56.529
	Non-EU	1.502.699	470.931	3.928.918	2.169.701	2.462.904	2.237.834	2.729.020
	Total	1.548.093	509.237	3.996.650	2.221.094	2.516.998	2.289.904	2.785.548

*: The same for baseline, strict baseline, 2015 implementation, 2025 implementation and current practise

Social impacts

In the following two tables are shown the results of the analyses of deaths as a result of accidents in the ship recycling facilities. The relative numbers of deaths compared to the baseline scenario are shown.

Table 0-13 Saved lives amongst adult ship recycling workers compared to the 2020 baseline (actual death numbers shown for baseline)

	2000	2005	2010	2015	2020	2025	2030
Baseline	3,0	0,9	7,9	4,3	2,4	2,2	2,7
Strict baseline	0,0	0,0	0,0	0,0	1,7	1,5	1,9
2015 implementation	0,0	0,0	0,0	2,2	0,0	0,0	0,0
2025 implementation	0,0	0,0	0,0	0,0	-2,5	0,0	0,0
Current practise	0,0	0,0	0,0	0,0	-2,5	-2,3	-2,8
Maximum (excl at risk)	0,0	0,0	0,0	2,2	1,8	1,6	2,0
Maximum (incl at risk)	-3,0	-0,9	-7,9	0,1	1,2	1,1	1,3

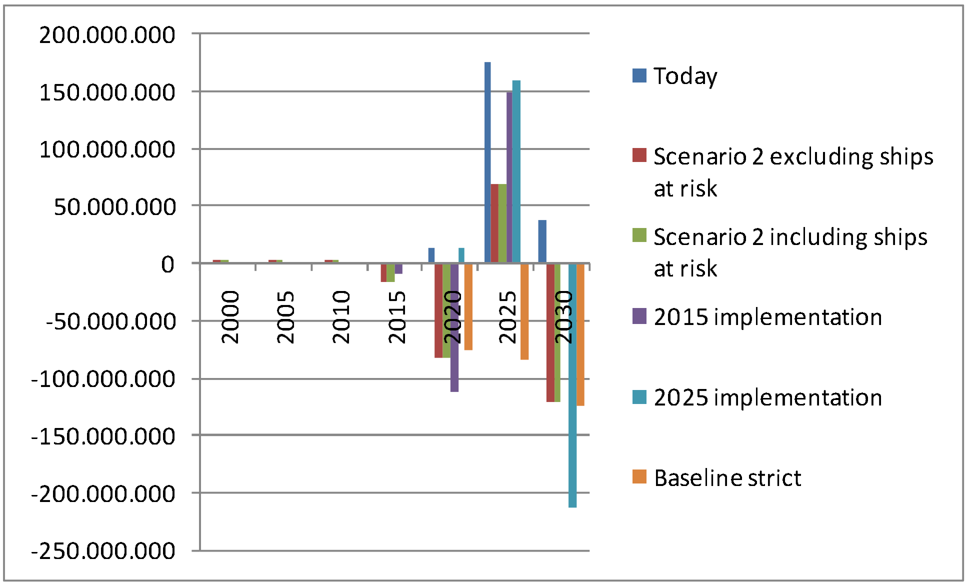
Table 0-14 Saved lives amongst child ship recycling workers compared to the 2020 baseline (actual death numbers shown for baseline)

	2000	2005	2010	2015	2020	2025	2030
Baseline	0,3	0,1	0,9	0,5	0,0	0,0	0,0
Strict baseline	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2015 implementation	0,0	0,0	0,0	0,5	0,0	0,0	0,0
2025 implementation	0,0	0,0	0,0	0,0	-0,5	0,0	0,0
Current practise	0,0	0,0	0,0	0,0	-0,5	-0,5	-0,6
Maximum (excl at risk)	0,0	0,0	0,0	0,5	0,0	0,0	0,0
Maximum (incl at risk)	-0,3	-0,1	-0,9	0,5	0,0	0,0	0,0

Economic impacts

In the following figure are shown an illustration of the results of the cost and revenues for the different scenarios compared to the baseline for the ship owners. Similar illustration for the public authorities exists within the study report.

Figure 0-1 Cost and revenue (+/-) to the ships owners compared to baseline in €



In the table beneath is represented the overall cost-benefit result for the different scenarios compared to the baseline. The cost includes are the sum of the cost for the ships owners and the administrative costs for Members States. The benefits included are from fewer accidents and deaths. A positive result means that the addition costs minus the benefits are higher than compared to the baseline scenario. So it can be concluded, that the society will experiences additional costs by choosing the never enter into force scenario compared to the baseline scenario including the entry into force of Hong Kong Convention.

Table 0-15 Cost-benefit results compared to the baseline scenario in €

	2000	2005	2010	2015	2020	2025	2030
Never enters into force	0	0	0	0	18.057.335	178.421.942	43.063.015
Scenario 2 (ekskl. ships at risk)	2.300.023	2.798.330	3.404.596	-18.243.782	-85.031.632	65.178.957	-126.168.502
Scenario 2 (incl. ships at risk)	2.300.023	2.798.330	3.404.596	-21.603.990	-88.288.401	60.650.395	-132.718.536
2015 implementation	0	0	0	-13.053.961	-111.418.543	149.062.972	0
2025 implementation	0	0	0	0	18.057.335	158.490.379	-213.854.922
Baseline strict	0	-4.155	-44.635	-29.807	-78.834.101	-87.043.184	-129.454.381

1 Introduction

This final report presents data collected and analysis made to support the Commission's impact assessment of a new legislative proposal on ship dismantling made under Study Contract No. 07.0307/2009/539107/G4.

The study was carried out by COWI A/S with input from LITEHAUZ ApS. The Study commenced in August 2009 and finalised in December 2009 upon submission of this Final Report incorporating comments from the Commission to the draft final report and the team's presentation thereof at a meeting in Brussels on 16 December 2009.

The methodology and the preliminary results were also presented at a stakeholder workshop held on 23 October 2009 in Brussels. Comments and specific data submitted by stakeholders have been reflected in the analyses to further qualify the estimates and support our findings.

1.1. Objective and study context

Study objective

The objective of the study is to provide as far as possible quantitative information to the Commission services on the potential impacts of two scenarios for implementation of the Hong Kong International Convention on the Safe and Environmentally Sound Recycling of Ships (The Hong Kong Convention).The impacts to be considered relate to environmental, social and economic impacts taking into account the Commission's guidelines for impact assessment.

The context and issues to the addressed

Since 2004, more than 80% of the larger (in terms of tonnage) end-of-life ships worldwide have been dismantled in India, Bangladesh and Pakistan. In these countries the "beaching" method is used, which means that the vessels are driven usually by their own steam onto sandy beaches and broken up without heavy machinery and without containment other than the hull of the ship itself. The remaining ships have been dismantled in other countries like China, Turkey and several EU Member States where capacity exists for ship dismantling.

The Hong Kong Convention, adopted on May 2009 under the auspices the International Maritime Organization, is expected, at the earliest, to enter into force in 2015. However, given the conditions for entry into force of the convention it is not unlikely that the waiting period would be longer 2020 or 2025). In order to enter into force, Article 17 of the Hong Kong Convention requires the signature of at least 15 States whose combined merchant fleets must constitute at least 40 per cent of the world's merchant shipping. In addition, the combined maximum annual ship recycling volume of these States during the preceding 10 years must constitute not less than 3 per cent of the gross tonnage of the combined merchant shipping of the same States. The Convention will enter into force 24 months after the date on which the aforementioned conditions are met. These particular entry into force provisions imply that ratification by both major flag and recycling States will be needed for the Convention to enter into force. Several experts, including at the IMO Secretariat, have indicated that the data on maximum annual ship recycling volumes suggest that ratification by China and India is necessary for the Convention's entry into force[10]. It is therefore important to note that there is currently some opposition in India to ratify the Convention because some shipowners consider that the Convention could ban beaching in the future.

Impact on ratification process and pace

Action or non-action by the EU can have an important influence on the ratification process and the effectiveness of the Hong Kong Convention in practice. If the EU does not act, this risks being seen by the international community as a sign that the ship dismantling problem is of low priority, and ratification by Member States and third countries is likely to take place with additional delays. If the EU, on the other hand, takes action, in accordance with the provisions of the Hong Kong Convention, this would carry weight in the international arena and could speed up the entry into force of the Convention. Experience with IMO conventions such as MARPOL and AFS has shown that third countries frequently ratify and implement an international agreement after the EU has made its rules binding for all ships within European waters.

Experience with IMO conventions suggests that it takes on average six years from adoption until entry into force of a convention. Some IMO Conventions have not yet entered into force at all, for example, the International Convention on Liability and Compensation for Damage in connection with the Carriage of Hazardous and Noxious Substances by Sea,[11] was adopted on 3 May 1996 but has not yet received the ratifications necessary for its entry into force. Another example is the Torremolinos Protocol of 1993 relating to the Torremolinos International Convention for the Safety of Fishing Vessels, adopted on 2 April 1977 and also not yet in force.

In the case of the Hong Kong Convention there is some expectation that the waiting period might stay below average and the Convention could come into force by 2015. However, given the conditions for entry into force of the Hong Kong Convention[12] it is not unlikely that the waiting period would be longer. The Convention may therefore, as indicated above, only enter into force as late as 2020 or 2025. As indicated in the Impact Assessment for an EU Strategy for

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[10] Most recently Mr Niklos Mikelis, IMO Marine Environment Division at a workshop on ship recycling and the Hong Kong Convention 23 – 24 October 2009 in Izmir, Turkey at which the entry into force conditions of the Convention were discussed. See http://www.denizcilik.gov.tr/dm/dosyalar/IMO%20Mr%20Mikelis.pdf.

[11] International Convention of 3 May 1996 on Liability and Compensation for Damage in connection with the Carriage of Hazardous and Noxious Substances by Sea

[12] See Section 2.6.1 p.17

better ship dismantling[13], without EU action it is probable that several Member States will, by their own decision, ratify the Convention and transpose it into their national legislation within the next two to four years. However, the statistics on ratification of IMO instruments show differing practices among the Member States and altogether considerable delay. The AFS Convention of 2001, for instance, was ratified four years later only by a minority of five Member States. Implementation of the Hong Kong Convention in the EU by purely national legislation is thus bound to be incoherent and partly delayed[14].

Moreover, and as further illustrated in section1.2, ratification and transposition by individual Member States of the Convention into their national legislation at different pace could lead to reflagging of ships, whereby ships would change their flag and exploit the available legal loopholes outside EU or within the EU by changing flag to another EU Member State not (yet) Party to the Convention or to non EU flag states.

Against this background, the Commission is considering different policy options that aim at redressing these unacceptable conditions in a timely manner. These proposals are put forth within the framework of the Integrated Maritime Policy for the European Union of October 2007. The European Commission has stated that, duly taking into account the ongoing work at international level, it will make proposals for dismantling obsolete ships in an efficient, safe and environmentally sustainable manner.[15] In the subsequent Commission communication of December 2008 setting out "An EU strategy for better ship dismantling[16]" possible EU actions to promote environmentally sound treatment of end-of life ships in the EU and worldwide are outlined.

The Strategy therefore reflects the call from the European Parliament to the Commission and Member States to take urgent action on this issue to counter the fact that currently ‘on various shores in Southern Asia and elsewhere enormous seagoing ships are dismantled under working conditions which are environmentally damaging and humanly degrading’.[17]

Most recently, the Environment Council has, at its October 2009 meeting, in response to the Ship dismantling strategy adopted conclusions encouraging EU member states to ratify the Hong Kong Convention as a matter of priority so as to allow its early entry into force. They also recognise the need for EU action to implement the convention, and invite the Commission to explore and assess measures that complement and advance the implementation of the convention, ensuring coherence with existing EU laws on ship recycling and the Convention.

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[13] COM (2008)767 final

[14] COM (2008)767 final p. 25

[15] COM(2007) 575 final

[16] COM(2008) 767 final

[17] European Parliament resolution of 21 May 2008 on the Green Paper on better ship dismantling available at http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2008-0222+0+DOC+XML+V0//EN

1.2 Flag at time of scrapping - the issue of reflagging

One very important issue when analysing impacts of new legislation targeting the shipping industry is the flag state regime, which allows the ship owners to change flag and by the same change the legal regime for the ship. This is especially important when evaluating a regional regulatory approach, e.g. a different regime at EU and international level, which could lead to a reflagging of ships, whereby ships would simply change their flag and exploit the available legal loopholes outside EU for instance. It is equally relevant to address the reflagging issue in the context of scenario 1 (no action at EU level) in which case ratification and transposition of the Hong Kong Convention by EU Member States is likely to take place at different pace. EU flagged ships could have an incentive to change flag to another EU Member State not (yet) Party to the Convention or to non EU flag states[18].

Change of flags is a natural part of a ship's life, for instance selling of a ship to a foreign owner could often be associated with a change of flag. Certain ship owners choose to sell of their ships when they reach a certain age, e.g. for economic reasons (maintenance cost, surveys and other).

Change of flags just before recycling of vessels to evade certain legal regimes and obligations (reflagging) is a well-known situation today. Furthermore, reflagging to non-party substandard flags for the oldest part of the fleet is a reality for many other IMO Conventions. The extent of reflagging of EU-owned vessels to evade a future EU legal recycling regime, or that of individual Member States having transposed the Hong Kong Convention, will depend primarily on the eventual loss in net revenue from scrapping the ships in environmentally sound dismantling facilities in accordance with the Convention requirements compared to traditional scrapping. Therefore even after the entry into force of the Hong Kong Convention, it likely that some reflagging will take place as long as some recycling countries are not Party to the Convention and therefore as long as two markets, one Convention compliant and one non compliant, are competing with each others.

We have analysed the nationality (flag) of the vessels scrapped and compared them to the nationality (flag) of the vessels during operation. The comparison is set out in table 1-1 below.

[18] In this context, it may be noted that the cost for a ship to change flag is approximately EUR 7000, and therefore as indicated by several stakeholders at the stakeholder workshop held on 23 October 2009 at DG Environment, would be a minor cost for the ship owner.

Table 1-1-1 Comparison of Top 25 flag states by scrapping and operation in 2008 (Gross Tonnage, GT)

1	Panama (7. 858.946)	Panama (183.503.000)
2	Liberia (3.782.618)	Liberia (82.389.000)
3	Tuvalu (1.622.954)	Bahamas (46.543.000)
4	Malta (1.268.069)	Marshall Island (42.637.000)
5	St. Kitts-Nevis (1.174.742)	Singapore (39.886.000)
6	St. Vincent & Grenadines (985.977)	Hong Kong 39.100.000)
7	Bahamas (866.141)	Greece (36.822.000)
8	Republic of Singapore (820.376)	Malta (31.633.000)
9	Unknown (715.099)	China (26.811.000)
10	Cyprus (708.852)	Cyprus (20.109.000)
11	Hong Kong (706.488)	Norway (18.311.000)
12	Mongolia (668.009)	Germany (15..283..000)
13	Norwegian International Register (621.710)	U.K. (15.247.000)
14	Marshall Islands (602.969)	S. Korea (14.145.000)
15	United States of America (511.715)	Italy (13.600.000)
16	Greece (395.253)	Japan (13.536.000)
17	People's Republic of China (377.692)	U.S.A. (11.268.000)
18	Comoros (270.651)	Denmark (10.570.000)
19	Cambodia (263.694)	Bermuda (9.952.000)
20	India (217.203)	Antigua & Barbuda (9.537.000)
21	Philippines (201.104)	India (9.283.000)
22	Russian Federation (199.849)	Isle of Man (8.965.000)
23	Republic of Korea (193.419)	Netherland (8.249.000)
24	Turkey (186.214)	Russia (7.527.000)
25	Dominica (158.505)	Malaysia (7.078.000)
	World total (27.821.376)	**World total (830.704.000)**

Source: The table has been drawn up based on data on Shipbuilding Statistics, September 2009 from the shipbuilders' Association of Japan for the top 25 flag states by tonnage – and on data from EMSA , LMIU for the top 25 flag states by scrapped tonnage.

The table's left columns lists the flags of registry for the 25 largest scrapping flag states comprising 91% of the scrapped volume. The column to the right shows the 25 largest flag states (86% of total) according their share of the World fleet tonnage. Both dataset are from 2008. Thus, if no reflagging occurs prior to a sale for scrap the two columns will be identical.

It is obvious, that even far up on the list of flags flown at the time of deregistration, flag states appear that were not on the Top 25 list for fleet tonnage. In particular, the following flags states appear to attract ships for scrap:

- Tuvalu
- St. Kitts-Nevis
- St. Vincent & Grenadines
- Mongolia
- Comoros
- Cambodia
- Dominica.

Current inter-EU re-flagging

The top seven flags accounted for 19,5 % of the world recycling tonnage in 2008 whereas the same flags accounted for less than 2 % of the world' operating fleet in 2008 indicating significant in-flagging to these seven flags in 2008 for end-of-life vessels.

The EU Member state flags accounted for 19% of the world tonnage in 2008. The EU members Malta and Cyprus accounted for a relatively higher percentage of scrapping compared to the percentage of flagged ships in operation (Malta: 3,8% of flags in operation and 4,5% of flags scrapped; Cyprus: 2,2% of flags in operation and 2,5% of flags scrapped), whereas the other large European Union Member States with significant merchant fleets drop on the list scrapped. These tendencies can very well be related.

The risk of flagging out as a consequence of increased regulation pressure is not unlikely and often brought forward in the assessment of impacts. Obviously, the economic implications for the shipowner of early transposition of requirements of the IMO Convention e.g. IHM on vessels or a requirement of mandatory recycling on EU recognised facilities will be compared to the cost and benefits of flagging to states with less stringent requirements. However, other factors also come into play and an economic projection for re-flagging is not available.

1.3 Data collection and inter-linkages to other studies

Complete and update information and data gaps

Against the background that publicly available data on all aspects of ship dismantling is rather limited, this study was initiated with a view to provide as far as possible quantitative information to the Commission services on the potential impacts of two scenarios for implementation of the Hong Kong Convention. The focus of the study has therefore been on completing and updating, to the extent possible, information and data gaps necessary for carrying out an impact assessment.

The Study is closely linked to and draws on several of the other Commission studies which have been launched to bring together data and information to facilitate the Commission's decisions making on the policy options to be further pursued.

It is a follow up study to a study that COWI undertook together with Milieu in relation to options for new initiatives regarding dismantling of ships, which inter alia reviewed the pros and cons of early EU transposition of the Hong Kong Convention on Ship Recycling and envisaged the implications of transposition of the Convention's key elements.

The current study also builds on previous COWI lead studies, namely:

- the study on Certification of Ship Recycling facilities[19] (for input and methodology for analysing future health, safety and environmental impacts on from EU flagged vessels)
- the study on ship dismantling and pre-cleaning of ships[20] (inter alia for the projections of future recycling of EU flagged vessels including governmental vessels)
- the study on the phase out of oil tankers and on the ship scrapping industry[21] (for input and methodology on generation of hazardous material).

However it is prudent to recall that the above mentioned studies were not tasked with generating new data, but to analyse selected challenges within the tanker area, the certification system, the economic conditions of recycling *etc.*

It was foreseen that the ongoing DG ENV/BIO study, establishing controllable criteria for identifying ships which could become waste in the short term concerning the so-called "ships at risk" calling EU ports, would provide estimates of the number of "ships at risk calling EU ports", including projections thereof. Whilst it has proven impossible for BIO, some data have been provided by BIO, in particular data on trends of world fleet in numbers and dwt based on type of ships. Based on amongst others these input the COWI team have made estimates of the ships at risk calling EU ports.

The team has liaised closely with desk officers in DG ENV and experts of the European Maritime Safety Agency (EMSA) on various data collection aspects, including with a view to draw on data on health and safety aspects of ship dismantling gathered in other ongoing Commission projects.

Stakeholder workshop to discuss methodology and preliminary results

A great number of representatives of industry, national and international authorities, NGOs and other stakeholders have been interviewed and contributed information to the study. Furthermore our methodology, main base data and the preliminary results were presented at a stakeholder workshop held on 23 October 2009 in Brussels. Views and specific comments expressed during and after the workshop are reflected in the relevant parts of the Report.

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[19] The 2008 COWI/Litehauz study for EMSA

[20] The 2007 COWI/DHI study for DG Environment

[21] The 2004 COWI study for DG Energy and Transport

1.4 Report outline

Following this introduction, **Chapter 2** explains in general terms the scenarios under consideration by the DG Environment.

Chapter 3 describes our approach to completing and updating the information and data gaps necessary for carrying out an impact assessment, in particular the methods applied for projecting future recycling volumes and destinations of EU vessels, HSE impacts as well as economic base data and approach to the assessment of economic impacts.

Chapter 4 and 5 provides the assessment of impacts of scenario 1 and 2 respectively, whereas **Chapter 6** provides comparisons of the impacts of the two scenarios.

Appendices to the report:

The analyses of impacts have been carried out using a dedicated Excel model on base data set for assessing the impacts of each of the scenarios. **This Excel model is attached in Appendix A**.

Appendix B comprises the results of the analysis assuming only 50 % compliance (except for waste oil) with EU ESM requirements for hazardous waste management in China.

2 The scenarios under consideration

The Commission has considered, with stakeholders, various options for better ship dismantling which will ensure that ships with a strong link to the EU are dismantled only in safe and environmentally sound facilities worldwide.

For the purpose of this Study the following scenarios for implementation of the Hong Kong Convention are addressed in the following chapters:

3 **Scenario 1: The baseline scenario** (No additional action at EU level). Under this scenario no policy change at EU level is envisaged. Upgraded beaching is considered as compliant with the Hong Kong Convention in the baseline scenario. It is assumed that the Hong Kong Convention is ratified by a sufficient number of flag and recycling states and enters into force in 2020. The following variants are also be addressed:

- The Convention enters into force in 2015
- The Convention enters into force in 2025
- The Convention would not enter into force

The Hong Kong Convention's guidelines describing what is considered as a safe and environmentally sound ship recycling are still being developed. In addition, there are diverging views regarding the possibility for beaching to be considered as compliant with the Hong Kong Convention. Therefore as a sub scenario 1a) we have analysed the implications of a situation were upgraded beaching would not be considered as compliant (strict interpretation of the Convention).

4 **Scenario 2: The reinforced scenario.** Under this scenario, the EU foresees to progressively increase i) the control on ships going for dismantling also targeting “ships at risk" and ii) the requirements for the acceptable methods for ship dismantling in order to meet in the mid term EU equivalent standards. This could happen either through a reinforcement of existing legislation or with a specific legislation to implement the Hong Kong Convention. The impact of extending the scope to warships and government vessels is also assessed. The EU measure would be proposed and applicable by 2014 at the latest.

2.1 Scenario 1: The baseline scenario (no additional action at EU level)

Under this scenario, no changes to existing EU legislation (notably the Waste Shipment regulation) or other new Commission initiatives on ship dismantling would be proposed – other than what would be strictly necessary to ensure coherence with existing EU laws on ship recycling and the Convention.

Almost all initiative in implementing the Hong Kong Convention would be left to Member States, including the exercise of sufficient influence on other flags and recycling States for the Convention to enter into force.

Under this scenario, it is considered that the Hong Kong Convention will be ratified by a sufficient number of flag and recycling states and will enter into force in 2020.

Transposition of the Convention, including making the inventory of hazardous materials and the ready for recycling certificate mandatory for shipowners would consequently depend on Member States' legislation. It is assumed that ratification and transposition by Member States will be at the same pace, so that Member States would provide for:

- By 2020 all new ships shall have on board an inventory for hazardous materials (IHM)
- No later than 2025 all existing ships shall have on board an updated IHM
- The verifications/surveys associated with the IHM and ready for recycling certificate and approval procedures thereof
- Recycling facility management plan and related requirements for ship recycling facilities in the respective Member States.

As indicated above, the IMO guidelines describing what is considered as a safe and environmentally sound ship recycling are still being developed. In addition, there are diverging views regarding the possibility for beaching to be considered as compliant with the Hong Kong Convention. For the purpose of the baseline scenario, it is assumed that upgraded beaching would be a Convention compliant dismantling method.

Variants – different dates for entry into force

The following sub scenarios will also be addressed:

- The Convention enters into force in 2015
- The Convention enters into force in 2025
- The Convention would not enter into force.

Sub scenario 1a) – beaching method not allowed

As a sub scenario 1a) we have analysed the implications should upgraded beaching not be allowed (strict interpretation of the Convention).

2.2. Scenario 2: The reinforced scenario

Under this scenario, new measures would be proposed and applicable by 2014 at the latest. The scenario consist in ensuring that ultimately ships that are likely to go for dismantling, are effectively sent to recycling facilities with a certain level of environmental, health and safety standards that progressively would meet EU equivalent standards.

Scope extended to warships and other government vessels

The scope of the EU measure would be the extended to government owned vessels, including warships. It will thus apply to ships entitled to fly the flag of a Member State or operating under its authority and to Ship Recycling Facilities operating under the jurisdiction of a Member State but not, small vessels below 500 GT and ships operating throughout their life only inside domestic waters.

The key elements of a new EU instruments

The EU instrument would transpose the key requirements of the Hong Kong Convention (not already covered under existing EU legislation) and to complement it with additional measures to ensure safe and environmentally sound ship dismantling. The following additional measures have been analysed in more detail:

- Extending the scope of the EU measure to government owned vessels, including warships;
- Obligation for all ship calling EU ports – as well as all EU-flagged ships - to have an updated inventory for hazardous materials (IHM). The requirement will be applicable from 2014 for new ships and for existing ships aged 15 years or more;
- Increased control of EU flagged and ships categorised as “ships at risks” calling EU ports in order to ensure that ships will be recycled at recycling facilities with a certain level of environmental, health and safety standards;
- Progressive introduction of such standards to allow for adequate capacity be made available: by 2014 recycling/treatment methods compliant with the Convention, by 2020 medium level (EU equivalent standards);

No financial mechanism to support implementation is foreseen.

3 Data collection, methodology and key issues to be kept in mind

Our approach to completing and updating the information and data gaps necessary for carrying out an impact assessment is described in the following subsections. We explain in detail how the main base data for the impact assessment have been generated, in particular the methods applied for projecting future recycling volumes and destinations of EU vessels, "ships at risk" calling EU ports, HSE impacts and economic base data etc.

The main base data set has been determined in close cooperation with DG Environment.

In our data and information collection we have drawn on existing reports addressing various aspects of ship dismantling several of which have been prepared by COWI and/or LITEHAUZ.

EMSA has kindly provided an extensive amount of data for instance updates on ship recycling volumes and destinations, size and distribution of flags at the time of scrapping and during operation, which has been used for address the size of re-flagging. Data and information have been provided by stakeholders following the expert workshop on the 23 October and by DG ENV.

A number of representatives of industry, national and international authorities and other stakeholders have been contacted in relation to contribute information to the study. The contacted representatives include:

- International Ship Recycling Association, ISRA
- International Chamber of Shipping
- European Ship Recycling Facilities such as Van Heygen Recycling S.A., Belgium and Scheepssloperij Nederland B.V., the Netherlands,
- Turkish Ship Breakers Association
- International Labour Organization, ILO (safety and health statistics)
- Gujarat Maritime Board.

In general limited information was available for the study.

The methodology and the preliminary results were presented at a stakeholder workshop held on 23 October 2009 in Brussels.

While comments and specific data submitted by stakeholders have been reflected in the analyses to further qualify the estimates and support our findings, the estimates, including the base data are best estimates subject to some uncertainty, given that publicly available data on various aspects of ship dismantling data is rather limited.

The analyses of impacts have been carried out using a dedicated Excel model and a base data set for assessing the impacts of each of the scenarios. This Excel model is attached in Appendix A.

3.1. Ship recycling volumes and destinations

3.1.1 Ship recycling volumes

An important input for the impact assessment is the expected future scrapping of European Vessels. The projections have been established based on the most recent public data set on ship dismantling available from DG ENV as reported by COWI/DHI in a 2007 report[22]. These data have been supplemented with information from EMSA on the most recent scrapping volumes. Furthermore, the COWI/DHI projection have been extended (to 2030) using estimates of the expected increase in sea freight volumes. This is further elaborated below.

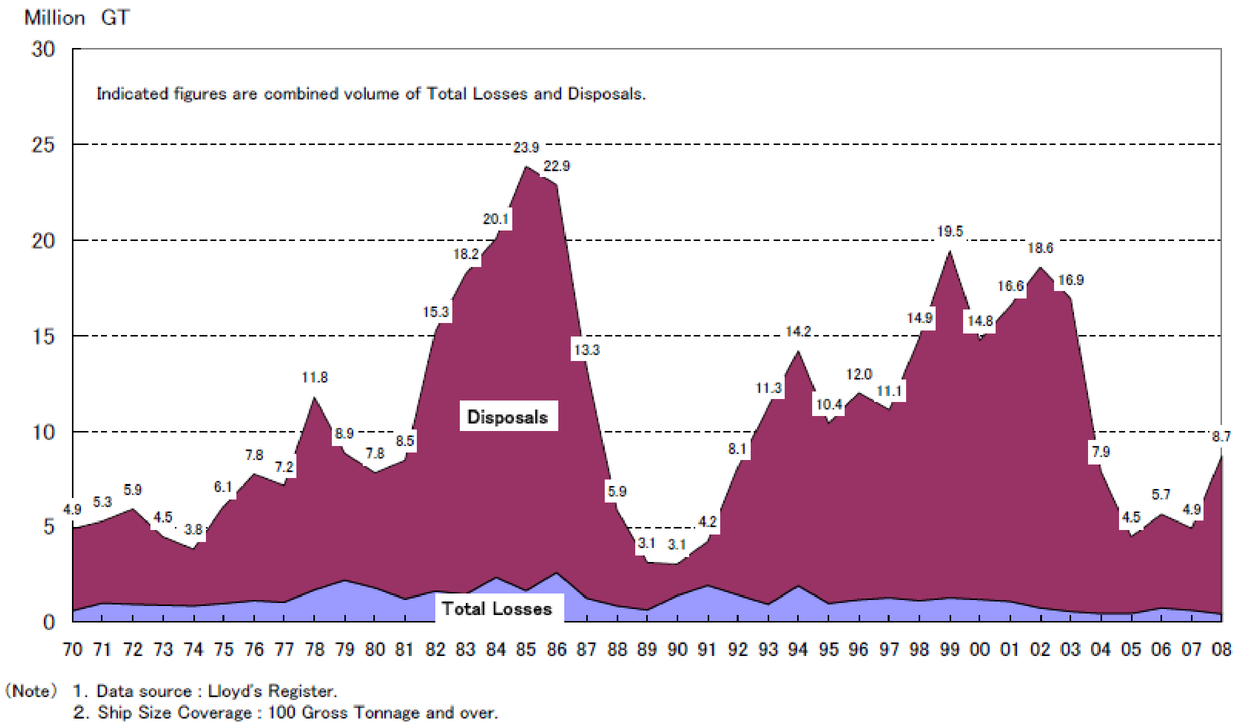
It should be noted that, the most recent data on actual scrapping are 2006 data. During this period, the freight market was booming and very few vessels were scrapped (contrary to the COWI/DHI 2007 projection). The reports directly from the main scrap areas suggest that only slowly in November and December 2008 did scrapping pick up (due to a dramatic drop in freight rates), and in the early part of 2009 the recycling beaches were seeing considerable business again. This surge in 2009 will not be reflected in the demolition databases for some time and a renewed data search will not clarify the picture with respect to the most interesting phase shift regarding supply and demand in ship recycling.

These trends are seen in the Figure 3-1 below showing the yearly removal of vessel from the world fleet during the last 38 years by total losses (incidents) and disposals[23].

[22] COWI/DHI/DG ENV: ‘Ship Dismantling and Pre-cleaning of Ships’ (2007)

[23] The Shipbuilders' Association of Japan, Shipbuilding Statistics, September 2009

Figure 3-1 World total losses and disposals, 1970 - 2008



The drop in 2006 and 2007 and the rise in 2008 and 2009 reflect the huge variations in freight rates. The fluctuations are expected to level out over time and therefore the projections in the 2007 COWI/DHI/DG ENV report is assess as a sound basis for the projection in this Study.

Projection of scrap volumes - key issues to be kept in mind

It is difficult to project scrap volumes. This is due to fluctuations in ship dismantling activities. The decision to dismantle a ship depends heavily on current market conditions, in particular, on the freight market. As freight rates fluctuate heavily so do the scrapping volumes. In 2005-2007 when freight rates where high almost no scrapping took place. On the other hand, with the current low freight rates, scrapping volumes are rising. However, conditions can change quickly and therefore the projected yearly scrapping volumes should be interpreted with care.

Methodology

The scrapping volumes is calculated and presented in Light Displacement Tonnage (LDT). The volumes are historical volumes up till year 2006 and projection from hereon until 2030.

The assessment includes the following vessel types:

1. (Single hull) Oil tankers
2. Other tankers
3. Bulk

4. Container
5. Gas
6. Passenger/ro-ro/vehicle (including ferries)
7. Other cargo vessels
8. Non-cargo vessels
9. Fishing vessels
10. Warships

The analysis include all vessels of 2.000 DWT and above for vessel type 1-8 (not the exact same limit for the Hong Kong Convention: >500 GT), fishing vessels of 500 GT and above[24] and warships of 150 LDT and above.

In the COWI/DHI 2007 analysis the scrapping volumes were calculated by country of ownership and flag State for EU. This implies that the projections were made for 4 categories:

- *EU flag/EU owned*
- *EU flag/Non-EU owned*
- *Non EU-flag/EU owned*
- *Non EU-flag/Non-EU owned*

The analysis covered the global fleet of vessel types 1-5 and 7-8, but only fishing (vessel type 9) and naval vessels (vessel type 10) which are flying the flag of an EU Member State and passenger vessels (vessel type 6) sailing to and/or from an EU country.

The projections were based on a simple assessment of the age profile of the fleet (for all other vessel types than oil tankers) and the historically observed life time expectancy.

The country of ownership for vessel types 1-5 and 7-8 was identified on the basis of the information provided in the Clarkson database[25]. It was not possible to determine the country of ownership directly for passenger ships. Instead it was assumed by looking at the vessels on each route in EU, that half the vessels

[24] The upper interval of vessels eligible for scrapping premiums in the EU exit scheme for fisheries, EC 2792/1999 is 500 GRT. Since in most cases the GT of a vessel is greater than its GRT slightly more vessels are included compared to the number of vessels subject to the EU exit scheme.

[25] Please note the following statement from Clarkson: "The term "Owners" within this product is used as a simplified term for "Primary Reference Companies". The Primary Reference Company is defined as the company with the main commercial responsibility for the ship and can be Owner, Manager, Agent or other associated company. None of the information contained in this product is intended to confirm or otherwise the legal status of the companies or the ships associated with them."

were owned by the country of origin and half by the country of destination. The information on flag state and route specific information was based on data from Shippax 'Statistics and Outlook 06'

Reference is made to the COWI/DHI 2007 Study for further elaboration on methodology applied for the projections including definitions of ship categories etc. The COWI/DHI study only includes projection until 2020. Volumes from 2020 to 2030 have been pragmatically estimated by applying the expected yearly growth in sea freight volumes as the yearly growth rate in demolition volumes[26].

The basis for applying the growth rate is the average scrapping volume in the period 2011- 2020 and not the projected volume in 2020, which is subject to fluctuations. The average total scrapping volume 2011-2020 is calculated to 5.96 million DT based in the data from the COWI/DHI 2007 report.

In the COWI/DHI 2007 study projections were made for the above mentioned 4 categories of ownership and flag State for EU. Average shares from 2007-2020 have been calculated on applied for the historical volumes (2000-2006) and the projections where these shares have not been calculated directly (2021-2030).

Results

The table below shows the historical and future volumes of demolition by owner/flag State.

Table 3-1 Historical and future volumes of demolition by owner/flag State and year of scrap (Million LDT)

Mill. LDT per year	2000	2005	2010	2015	2020	2025	2030
In total	4,90	1,60	17,90	6,40	6,50	7,25	8,82
hereof							
EU flagged and owned	0,90	0,29	2,40	1,20	1,50	1,33	1,62
EU owned, not EU flagged	0,96	0,31	3,10	1,30	1,20	1,42	1,72
EU flagged, not EU owned	0,14	0,05	0,30	0,30	0,20	0,21	0,26
Not EU flagged, not EU own.	2,90	0,95	12,00	3,70	3,60	4,30	5,23

The table shows large variations in the scrapping volumes reflecting large fluctuations in freight rates and the regulation calling for mandatory phase-out of

[26] An expected yearly growth in sea freight volumes of 4% is applied based on information from Perspectives on the Shipping Super Cycles by Martin Stopford. Blue Event 17 - 01 October 2009. http://cbs.dk/videreuddannelse/masteruddannelser/mba_uddannelser/executive_mba_in_shipping_logistics_the_blue_mba/menu/blue_mba_events)

single hull tankers by year 2010. In 2005 the scrapping activity reached an "all time low" of only app. 1,5 mill. LDT being scrapped. On the other hand the scrapping volumes are expected to peak in 2010 where a large number of single hull oil tankers are foreseen to be phased-out due to regulation resulting recycling in a volume up to around 18 million LDT.

It can also be seen that the forecasted total annual recycling volumes rise steadily from 2015 to 2030 from 6,4 to 8,8 million LDT.

Vessels owned by non-EU countries and flying the flag of non-EU countries account for the largest share of future scrapping - app. 60%. The analysis further shows that EU-flagged vessels (both EU-owned and non-EU owned) would account for app. 20% of the scrapped tonnage.

Based on information from COWI/DHI 2007, the vessel types with the smallest decommissioning volumes are warships and fishing vessels. The projected annual dismantling volume for European warships including other government owned vessels is approximately 40.000 LDT per year and compared to the merchant fleet it accounts only for a very small fraction (approximately 1%) of total dismantling.

3.1.2 Ship recycling destinations

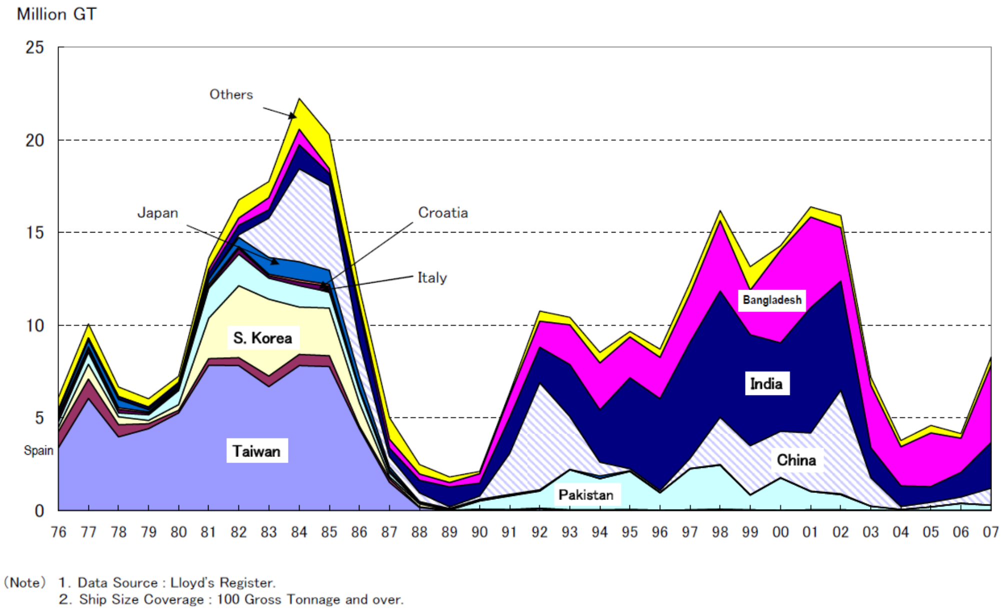
Another very important input for the impact assessment is the expected future scrapping location of European Vessels.

Looking back 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 South 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.

The longer historical trend for the last 30 years period within recycling location are seen for the last 30 years trends (1976 - 2007) in the figure[27] below. From the figure it can be seen the shift in recycling locations experienced around the mid 1980's, where the South-East Asian countries India, Bangladesh and Pakistan together with China took over and have since completely dominated the recycling business. This pattern within recycling locations is anticipated maintained for the projections of the impact assessment.

[27] The Shipbuilders' Association of Japan, Shipbuilding Statistics, September 2009

Figure 3-2 World disposals by country of breaking for the years 1976 - 2007



The detailed projections for the impact assessment have been established based on the most recent public data set on ship dismantling available from DG ENV via EMSA. The Table below show the 10 largest ship recycling nations based on recycling GT within 2009[28].

28 Data from EMSA based on LMIU, received in mail 13 October 2009

Table 3-2 The 10 largest ship recycling nations based on recycling volumes GT within 2009

Recycling country	Sum of Vessel, GT	Of total GT, %	Cumulative, %
Bangladesh	9.049.068	32,5	32,5
India	8.133.311	29,2	61,8
People's Republic of China	5.985.053	21,5	83,3
Pakistan	2.158.197	7,8	91,0
Turkey	748.782	2,7	93,7
United States of America	414.532	1,5	95,2
Indonesia	217.496	0,8	96,0
Republic of Korea	194.264	0,7	96,7
Portugal	87.490	0,3	97,0
South Africa	71.465	0,3	97,3

For the recycling projections, the recycling locations are grouped according to the recycling methods applied and geography like shown in the following table. The recycling percentages are calculated from the recent historical recycling data for the world fleet received from EMSA via DG ENV by summing up the percentages for the individual countries. A small fraction of less than 3% recycling in OECD non-EU countries have been distributed relatively between the beaching method: India, Bangladesh and Pakistan and the afloat method: China. The applied method thus includes using the following recycling location percentages for the years up to the entry into force of the different policy measures.

Table 3-3 Recycling locations in terms of percentage of total recycling (GT based) in 2009

Recycling location	Method	Recycling fraction of total, %
India, Bangladesh and Pakistan	Beaching	71,79
China	Afloat	22,22
OECD non-EU	Landing, afloat and unspecific: Landing in analyses	5,05
EU (of this UK)	Slipway (docking)	0,95 (0,06)
Total		100

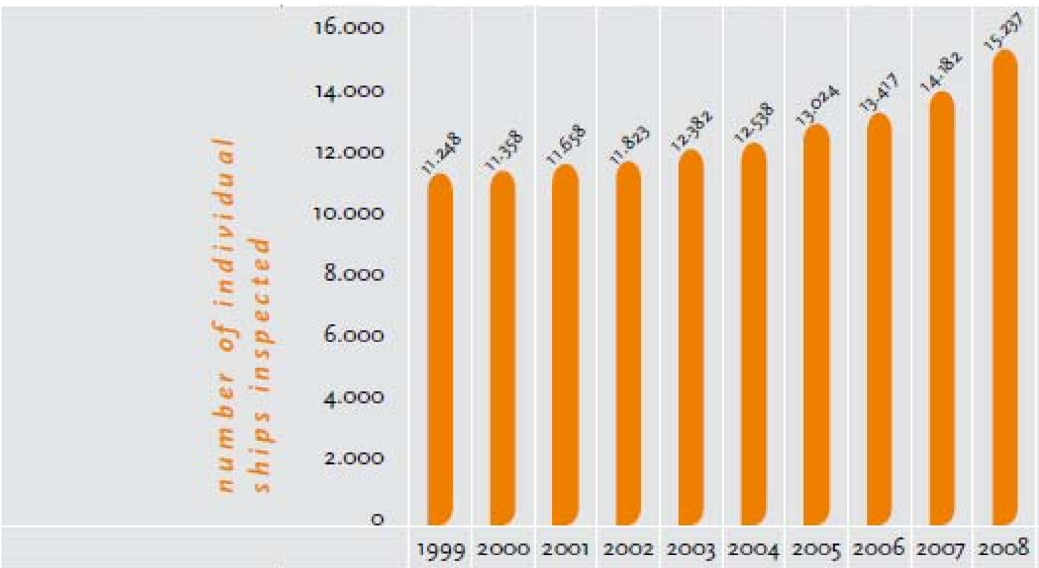
3.2 Potential volumes of ships at risk calling EU ports

Information from BIO – basis for estimation of potential volumes

One of the policy options identified by the Commission includes the policy measure of targeting ships which are calling EU ports and which are identified to be "at risk" for being recycled within a near future. The Commission has launched a study on the development of a model to identify such "at risk" ships. This study is being performed by Bio Intelligence Service (Bio), who has provided information[29] being used below as part of the basis for estimating the future number of ships "at risk" calling EU Ports. The number of non-EU flagged "at risk" ships calling EU ports are the potential extra ships being targeted by this scenario option.

The following figure shows data from the Paris MoU 2008 Annual Report on ships calling to EU ports[30] and includes reports on the MoU Port States' individual contribution to the total amount of inspections.

Figure 3-3 Data from the Paris MoU 2008 Annual Report on ships calling to EU ports



[29] Ship_Dismantling_Forecasts_BIO.doc received in e-mail dated 6 November 2009 from Mary Ann Kong

[30] http://www.parismou.org/upload/anrep/VerkWatstaat_BW%20LR1.pdf

Table 3-4 Individual MoU Port States contribution to the total amount of inspections in 2008

MOU port State	Individual Ships Calls	Inspections	Inspections with deficiencies	Detentions	Detents with RO related deficiencies	%-Insp. with deficiencies	% Detained	% Individual Ships inspected (25% commitment)	% Inspection of MOU total
Belgium	5246	1481	843	70	17	56,92	4,73	28,23	6,01
Bulgaria	1362	528	397	30	5	75,19	5,68	38,77	2,14
Canada[1]	1739	553	208	23	7	37,61	4,16	31,80	2,24
Croatia	1490	401	289	33	4	72,07	8,23	26,91	1,63
Cyprus	1059	329	212	55	4	64,44	16,72	31,07	1,33
Denmark	2436	659	314	23	2	47,65	3,49	27,05	2,67
Estonia	1571	383	125	4	0	32,64	1,04	24,38	1,55
Finland	1332	492	138	3	0	28,05	0,61	36,94	2,00
France	5889	1780	1087	91	5	61,07	5,11	30,23	7,22
Germany	5427	1403	784	47	6	55,88	3,35	25,85	5,69
Greece	3075	1003	439	45	12	43,77	4,49	32,62	4,07
Iceland	382	103	33	1	0	32,04	0,97	26,28	0,42
Ireland	1390	435	202	30	4	46,44	6,90	31,29	1,76
Italy	6567	1929	1270	212	30	65,84	10,99	29,37	7,83
Latvia	1864	515	229	5	0	44,47	0,97	27,63	2,09
Lithuania	1406	441	325	9	0	73,70	2,04	31,37	1,79
Malta	817	294	223	21	4	75,85	7,14	35,99	1,19
Netherlands	5820	1633	873	41	2	53,46	2,51	28,06	6,63
Norway	2343	734	269	22	4	36,65	3,00	31,33	2,98
Poland	2343	789	447	33	1	56,65	4,18	33,67	3,20
Portugal	2684	986	529	39	8	53,65	3,96	36,74	4,00
Romania	1907	1101	811	31	3	73,66	2,82	57,73	4,47
Russian Fed.[2]	3325	1470	953	54	7	64,83	3,67	44,21	5,96
Slovenia	779	298	113	53	14	37,92	17,79	38,25	1,21
Spain	6608	2324	1620	165	24	69,71	7,10	35,17	9,43
Sweden	2686	763	262	9	0	34,34	1,18	28,41	3,10
United Kingdom	6478	1820	1327	71	11	72,91	3,90	28,10	7,38
Total	78025	24647	14322	1220	174	58,11	4,95	31,59	100,00

By combining information from the above figure and table can be seen that in 2008 the 27 members of the MoU agreement carried out 24.647 inspections on 15.237 individual ships. Each individual ship has thus on average been inspected 1.62 times per year, a rate which has changed little since 1999 according to Bio. For the EU Members can be calculated a total number of individual ships calls of 68.746 and 21.386 inspections in 2008.

A high estimate of the total number of individual ships calling EU ports within a year can be generated by applying the average individual inspection frequency of 1,62 on the individual ship calls in EU ports within a year. This will be overestimating the number of individual ships calling EU ports within a year, as the Paris MoU rules target ships with certain characteristics (flag, age, maintenance records etc.), resulting in higher representation of such ships. A low estimate of the total number of ships, which were calling an EU Port in 2008, is the actual individual ships inspected under the Paris MoU in EU Ports, namely 13.201 ships.

Comparing the high and low estimates of individual ships calling EU Ports to the total world fleet, as provided by Bio and listed in the following table gives a range of 19% - 61% of the total world fleet (numbers) calling EU ports in 2008. For the following analysis of impacts an average of 40% (27.800 ships in 2008) of the entire world fleet visiting EU within a year is used.

Table 3-5 Trends of world fleet in numbers and dwt, based on type of ships 100 GT ≥[31]

Type of ship		2006	2007	2008	2009	2010	2013	2015	2020	2025	2030
General Cargo	#	18 102	18 466	18 816	19 173	19 652	21 090	21 934	24 017	26 298	28 796
	GT (mil)	60	62	64	66	67	73	77	88	101	116
Specialized cargo ships	#	240	249	255	264	273	300	321	378	446	526
	GT (mil)	2	3	3	3	3	4	5	7	11	16
Container ships	#	3 960	4 309	4 653	5 025	5 489	6 884	7 985	11 179	15 650	21 910
	GT (mil)	113	126	139	153	167	212	255	382	573	859
Ro-Ro Ships	#	1 588	1 632	1 680	1 730	1 782	1 937	2 053	2 360	2 714	3 121
	GT (mil)	35	38	41	43	45	50	57	77	103	138
Bulkers	#	7 240	7 488	7 712	7 943	8 697	10 961	11 618	13 360	15 364	17 669
	GT (mil)	207	218	229	241	265	337	371	463	579	724
Oil and chemical tankers	#	10 656	11 092	11 535	11 996	12 235	12 955	14 034	16 840	20 208	24 249
	GT (mil)	219	233	246	260	267	286	320	416	541	704
Gas tankers	#	1 297	1 360	1 428	1 499	1 555	1 724	1 896	2 370	2 963	3 728
	GT (mil)	31	34	38	41	43	50	60	89	134	202
Other tankers	#	379	385	391	397	403	421	434	466	500	538
	GT (mil)	8	8	8	8	8	9	9	10	10	11
Passenger ships	#	6 253	6 335	6 398	6 461	6 486	6 564	6 695	7 029	7 380	7 749
	GT (mil)	30	31	32	34	34	35	38	45	54	64
Service ships	#	4122	4 174	4 224	4 308	4 359	4 514	4 622	4 899	5 086	5 391
	GT (mil)	9	10	10	11	11	13	14	18	21	27
Tugs	#	11491	11 955	12 409	12 880	13 363	14 812	15 937	18 965	22 568	26 855
	GT (mil)	3	3	4	4	4	5	5	6	8	10
TOTAL	#	**65 328**	**67 445**	**69 501**	**71 676**	**74 294**	**82 162**	**87 529**	**101 863**	**119 177**	**140 532**
	GT (mil)	**717**	**766**	**814**	**864**	**914**	**1074**	**1211**	**1601**	**2135**	**2871**

Assuming that 40% of the total world fleet will visit EU Ports each year the number of visiting ships can be calculated from the above table.

Table 3-6 Estimated number of different ships calling EU Port(s) yearly

	2009	2010	2013	2015	2020	2025	2030
Total, #	28.700	29.700	32.900	35.000	40.800	47.700	56.200

Making rough assumptions about the world fleet being uniform in terms of size and sail patterns so that the fleet visiting EU Ports within a year is equal to the average world fleet in terms of age, flag-state etc. we can assume that 40 % of

[31] Ship_Dismantling_Forecasts_BIO.doc received in e-mail dated 17 November 2009 from Mary Ann Kong

the world LDT is visiting EU within a year. As EU-flagged ships account for around 20 % of the world LDT, the EU policy option, which is targeting both recycling of EU-flagged ships and all "at risk" ships, which has been visiting EU ports, will have an outreach, which is double, in terms of weight, that of a policy option only targeting EU-flagged ships. The "at risk scenario" can thus theoretically have a double beneficial impact compared to the other scenarios.

3.3. Projections of potential impacts - different compliance levels for recycling facilities

The active recycling countries can generally be characterised by the recycling method applied, as defined in the Table below for the four overall recycling methods: beaching, landing, afloat and docking.

Table 3-7 Recycling methods applied in present recycling countries

Recycling method	Countries applied
Docking	Few places in Europe
Afloat	China, Europe and US
Landing	Turkey
Beaching	South-east Asia: Bangladesh, India and Pakistan

Each of the four different recycling methods is associated with a certain HSE quality level, which is used as basis for assessing the HSE impacts of the different policy scenarios. The quality levels of the present beaching facilities are below the proposed Convention standards, whereas the three other methods in general characterise three different compliant levels.

The three-levelled compliance system, as proposed in the 2008 EMSA study[32], forms input to the generation of data for the impact assessment where no historical statistics exist. This three-levelled system operates with three quality levels A, AA and AAA where an A level indicates implementation of IMO minimum levels – in the adopted Convention text and guidelines this includes beaching – and two more compliant levels: the top level (AAA) is indicative of the full standard with double containment in dry dock facilities and the medium level (AA) comprising the existing pier and slipway breaking such as carried out in Europe and in China, and represent the ultimate (innovative) upgrading possibility for beaching and landing facilities.

32 European Maritime Safety Agency (EMSA). Study on the Certification of Ship Recycling Facilities. September 2008. COWI/Litehauz. https://extranet.emsa.europa.eu/index.php?option=com_docman&task=doc_download&gid=620&Itemid=193

3.4. Health, Safety and Environmental impacts

The environmental, health and safety (social) impacts of the different EU policy scenarios are estimated by means of a base data set for HSE performance for the different recycling methods and locations.

The HSE base data set and the approach applied to estimation of this is described in the subsections below.

3.4.1 Accidents

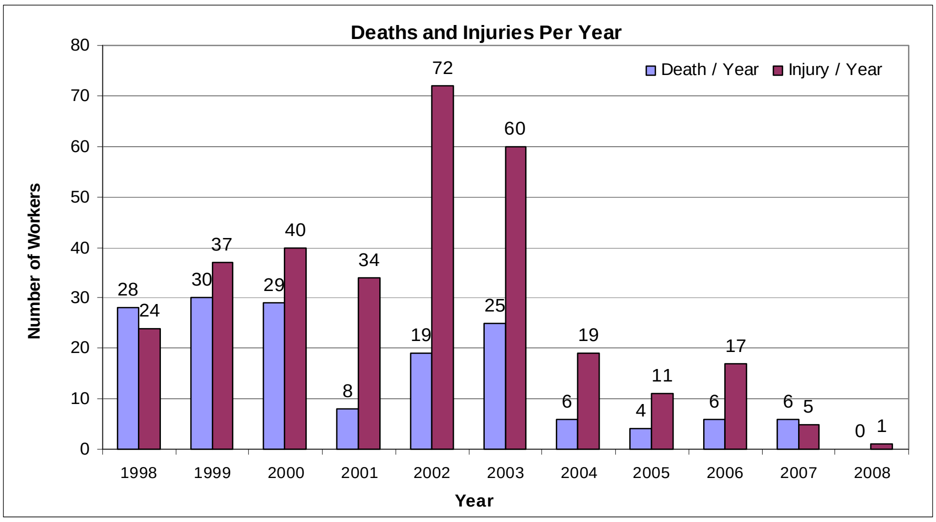
It is very difficult to obtain quantitative information on the health and safety performance, i.e. the number of fatal and non-fatal accidents, at the different recycling facilities. For almost all recycling facilities and nations these data are not collected and publicly available. For some locations, e.g. Europe, the data is collected on a national level as part of data from other industries, and is thus not available for the ship recycling industry alone.

Different information sources have reported some data on the number of accidents, fatal and non-fatal. This information is presented below and have been put together to make estimates for the impact assessments. One additional problem in estimating the number of accidents, in the different ship recycling locations, is that different practise is applied, for classifying an incident as an accident in Europe and in Asia.

South-East Asia

Publicly available information on accidents, fatal and non-fatal within the South-East Asian recycling locations is presented below.

Figure 3-4 Number of deaths and injuries reported per year to hospital, Alang[33]



[33] *Source*: Safety Training and Labour Welfare Institute, GMB, Alang - Information provided by DIVEST coordinator following the stakeholder consultation of 23 October 2009.

Preliminary and non-public available updated information from an ongoing EU study in India indicate fatality numbers which are around double the above numbers for the last few years[34], which could be because it includes all deaths and not only the once occurring in the hospital.

The Gujarat Maritime Board (GMB) in India has revealed figures related to accidents and casualties for the years 1997 - 1999, see below table (please note that the source for the Gujarat data in Figure 3-4 and Table 3-8 are not identical).

Table 3-8 Incidents at Alang ship recycling facilities in India, reported by Gujarat Maritime Board (ILO, 2001)

Year	No. of workers	Fatal incidents	Deaths	Non-fatal incidents	Injuries	Total No. of incidents
1997	25.000	31	46	3	23	34
1998	25.000	18	26	24	41	42
1999	25.000	26	30	28	36	54
Average	25.000	25	34	18 (26)	33 (38)	43 (48)

Greenpeace estimates that around 1,000 – 1,200 workers have died over the last three decades at Alang, India (Greenpeace/FIDH, 2005).

A very active NGO in Bangladesh Young Power in Social Action, YPSA (YPSA, 2006) refer a study carried out by Roy (2003), showing the following:

- 88% of the ship recycling workers suffered from some form of accidental injury from foot injury to larger accidents
- 87% suffered from muscle pain
- 72% have problems with eyesight
- 52% have breathing difficulty
- 81% of labourers have gastric problems
- 56% suffered from skin diseases and
- 28% have other infections.

Turkey

From the Divest projects the following information on the Turkish ship dismantling industry[35] have been made available for this study (direct quote):

- "Number of Non-Fatal Incident in Shipbreaking yard where approximately 1.000 people work, is approximately 425 during 1985-2009.

[34] Information provided by DG ENV

[35] Information provided by Divest Project in email dated November 5 2009

- Since 2003 there has not been single fatal accident in the shipbreaking yard industry. The reasons for such a low number can be listed as:
  1- All the workers are minimum graduate of Primary school and literate (can read and write, It is compulsory)
  2- All the workers have to complete compulsory trainings while Turkish Ship breaking Association organise regular training courses on Job related, safety related, Health Related as well as Emergency Response
  3- Most of the workers have been working in the same field for long time and has vast amount of experience. Most of eth workers have more than 10 years of experience
  4- By law no people below 18 years old is permitted to work
  5- It is compulsory to wear protective clothing
  6- Most of the younger people are graduate of technical colleges geared for the jobs in the ship breaking yards
  7- Regular inspection by the government health and safety officials and Workers are subject to regular health-check-ups
  8- Constant Upgrading the tools and technologies used as well as facilities
  9- Extremely well regulated Handling of Hazardous materials (According to EC standards) by centrally organised Waste management Centre and their specialist technical people, who are the only people that can handle hazardous material
  10- Ministry of Environment, Local Authorities, Ship Breaking Associations, which has unique authority for handling Hazardous materials, preparation of documents and communication with Authorities, form a extremely well working process
  11- Extremely transparent and open process
  12- Turkey not only follows ILO, BASEL and IMO but also follows the EC requirements".

Europe

A considerable effort has been carried out to obtain information on the safety statistics for the European ship recycling nations via direct contacts to local, regional and national authorities and agencies in amongst others Denmark, UK, Poland, Holland and Belgium.

Accident data from other larger and comparable European sectors, in terms of danger level and technical familiarity, have been identified for estimation of the accident rates within the European ship recycling industry.

Ship recycling is considered amongst the most dangerous occupations. According to the European Agency for Safety and Health at Work the accident rate within some of the most dangerous work sectors in Europe: agriculture and construction are around 13 fatalities per 100.000 man-years and around 6.000 accidents per 100.000 man-years[36].

According to HSE UK the average yearly all reported incident rates within the ship building industry in UK, which is considered technically familiar to ship recycling in EU in the period 1996 - 2002 was 2.150 per 100.000 man-year[37].

China

No accident statistics have been identified from China.

Comparison and conclusion

The following table includes the calculated accident rates for the above information.

[36] http://osha.europa.eu/en/statistics

[37] http://www.hse.gov.uk/aboutus/meetings/committees/ships/031203/49accstats.pdf

Table 3-9 Calculated accident rates for different sectors

Location	Fatality rate per 100,000 man-years	Accident rate (non-fatal) per 100,000 man-years	Year of data	Comments	Reference
India	136	132	1997 - 1999		GMB
	407[38]	-	1976 - 2006		Greenpeace
	37[39]	89	2004 - 2008		GMB (Safety Training and Labour Welfare Institute)
	92[40]	178	1998 - 2003		GMB (Safety Training and Labour Welfare Institute)
Turkey	0	-	2003 - 2009		GMB (Safety Training and Labour Welfare Institute)
	-	1.700	1985 - 2009		GMB (Safety Training and Labour Welfare Institute)
Europe	13	6.000		Different sectors: agriculture and construction	European Agency for Safety and Health at Work
UK	-	1.460 - 2.604* (2.150)**	1996 - 2002	Different sector: ship building and ship repair	HSE UK

*: Range of yearly all reported injury rates (including fatal injuries)

**: Average yearly all reported injury rate for a six years period 1996 -2002

Table 3-9 above show that the calculated accident rates for India are lower than the once for Turkey, which are again lower than the rates for EU. This is opposite to what are expected based on reports on the general safety culture and recycling practises on the different recycling locations. This trend obviously illustrates a mismatch, which is most likely related to different definitions and classifications of non-fatal accidents between the recycling sites where more also smaller accidents and incidents are registered in EU than in India. This will lead to an underestimation of the total accidents in India.

[38] Based on an estimate of an average of 9.000 man-years per year over the last three decades at Alang

[39] Calculated from an assumption of 12.000 man-years per year at Alang in the period 2004 - 2008, because of the lower activity level in most of this period

[40] Calculated from an assumption of 25.000 man-years per year at Alang in the period 1998 - 2003

In view of the quality of the available quantifiable data and the general information on the health and safety status and performance of the different ship recycling locations, it seems more appropriate to apply the theoretical health and safety benchmarks as described in the EMSA Triple-A system, which is based on EU accident statistics from the most dangerous occupations (agriculture and construction) and an assumption that the combination of geography and recycling method results in that accident rates increase from EU facilities to afloat facilities in China and again to Turkeys landing facilities and finally to beaching facilities in South-East Asia. As a result of the HSE improvements seen in Indian facilities during recent years these are estimated already A-compatible in terms of accidents, which the most resent death statistics (2004 - 2008) also seems to indicate.

For the impact assessment, it is thus assumed that the Indian facilities at present have a better health and safety performance than the facilities in Bangladesh and Pakistan.

Table 3-10 Theoretical health and safety benchmarks for accidents and fatalities as described in the EMSA Triple-A system[41]

Indicator	Minimum A	Medium AA	Premium AAA
Accident rate	Accidents are investigated and corrective and preventive actions implemented. The effectiveness of these is controlled and documented. Five years rolling average reduction targets are met. The max. rate being 18.000 accidents with more than three days absence per 100.000 men per year (normalised) or national targets whichever is lowest	Four years rolling average reduction targets are met. The max. rate being 12.000 accidents with more than three days absence per 100.000 men per year (normalised) or national targets whichever is lowest	Incidents and near-misses are also recorded, analysed and corrective and preventive actions implemented. Three years rolling average reduction targets are met. The max. rate being 6.000 accidents with more than three days absence per 100.000 men per year[42] (normalised) or national targets whichever is lowest
Fatality rate	The fatality rate and reduction goals for the facility are publicly available. Compensations are paid. Five years rolling average reduction targets are met. The max. rate being 39 fatalities per 100.000 men per year (normalised) or national targets whichever is lowest	Four years rolling average reduction targets are met. The max. rate being 26 fatalities per 100.000 men per year (normalised) or national targets whichever is lowest	Three years rolling average reduction targets are met. The max. rate being 13 fatalities per 100.000 men per year[43] (normalised) or national targets whichever is lowest

Using the mostly theoretically based accident data are of course associated with a considerable uncertainty in terms of actual numbers, but is however expected acceptable for comparison of the relative differences between the scenarios.

For the current situation in Bangladesh and Pakistan no information on accident rates exists. Instead the available few years old accident statistics from India is applied. The Indian data stem from before the recent HSE upgrade at (some) of

[41] The 2008 COWI/Litehauz study for EMSA

[42] EU accident rate within some of the most dangerous work sectors: agriculture and construction according to European Agency for Safety and Health at Work

[43] EU fatality rate within some of the most dangerous work sectors: agriculture and construction according to European Agency for Safety and Health at Work

the India facilities. As beaching is applied in all three countries and as a comparable HSE upgrade, as seen in India, has not been seen in Pakistan and Bangladesh, it seems acceptable to apply the few years old fatal accident rates from India for the current situation in Pakistan and Bangladesh.

As described above the reported non-fatal accident rates for India are most likely far below the comparable EU rates as a result of a different accident reporting culture in India. For the assessment of impacts are thus instead applied a non-fatal accident rate of 31.450 per 100.000 man-years for the current situation in Bangladesh and Pakistan. This rate is the average of the reported Indian rates and a calculated non-fatal accident rate obtained by applying the EU rate between fatal and non-fatal accidents (462 non-fatal accidents per fatal accident in the most dangerous occupations in EU: agriculture and construction) on the actual reported fatal accident rates in India.

3.4.2 Child labour

The issue of the existence of child labour within the ship recycling facilities is very difficult to assess, as no official information on this issue exist.

A 2008 report from Bangladesh published by FIDH and YPSA[44] estimate that about 25% of the workers on the Bangladeshi recycling yards are children.

Other sources quote an YPSA baseline survey in 2003 indicating that 10,9% of the labour force is children (age up to 18)[45].Several other sources mention that children are engaged in ship recycling in both Bangladesh and Pakistan, but do not indicate numbers.

An extensive survey of the working conditions for shipbreakers in India carried out by the International Metalworkers' Federation[46] does not mention child labour, whereas for instance Mr. Shiri V.V. Rane - Secretary, Mumbai Port Trust, Dock and General Employees Union indicate that children are employed in the ship recycling business for light work, e.g. cutting asbestos[47]. Input from the Indian recycling industry for the impact assessment claim that no child labour exist at Indian facilities, which is partly back by a not yet public study of DG Environment, which indicates that children are employed within the ship recycling industry in India, but not directly engaged in the actual dismantling processes.

For the impact assessment is used an estimate of 17 % of the total labour force within the ship recycling industry in Bangladesh and Pakistan are children (av-

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[44] Childbreaking Yards. Child Labour in the Ship Recycling. FIDH and YPSA in cooperation with The International Platform on Shipbreaking

[45] http://www.shipbreakingbd.info/Rights%20violation.htm

[46] Status of Shipbreaking Workers in India - A Survey on Working and Socio-Economic Conditions of Shipbreaking Workers in India. IMF-FNV project in India, 2004-2007

[47] Speech to the GMB Trade Union Congress 2007 - Brighton. http://www.gmb.org.uk/Templates/Internal.asp?NodeID=95634

erage of the percentages reported for Bangladesh). No child labour is estimated for the Indian facilities.

Child labour is not acceptable according to international Conventions and is thus not acceptable in yards complying with EU requirements.

3.4.3 EU waste management requirements and present hazardous waste management practices within main ship recycling locations

Introduction

Substances resulting from the ship recycling may cause direct and indirect threats to environment and health. In this subsection we have outlined how the main hazardous material regulated under the Hong Kong Convention are regulated in the EU with regard to restrictions for use on ships and regard to waste management[48].

Notes on how these substances are managed today in the three major South-East Asian recycling states are further included. Additionally, it is described how these substances are addressed in the impact assessment in terms of waste volumes generated by recycling of ships.

Based on information from various sources the existing practises of hazardous waste management from ship recycling facilities are most advanced in China and Turkey and lesser so in Bangladesh and Pakistan. Efforts have been made for the last years to upgrade the practise in India, so that they today are placed somewhere in between the level of China/Turkey and that of Bangladesh/Pakistan.

For China and Turkey[49] waste management practises comparable to that of the EU requirements are used as a basis for the main impact assessment. In view of the fact that in the case of China, very limited official information exists and/ or is publicly available, the assumption of EU compliance of the waste management from Chinese facilities is associated with some uncertainty. Therefore a situation with 50% compliance of the waste management at Chinese facilities (except for oil, which is most likely reused) compared to EU requirements has been analysed. The results of this analysis are placed in Appendix B.

In general, for the South Asian ship recycling locations, India, Bangladesh and Pakistan not much information on the fate of hazardous waste is readily avail-

[48] Other hazardous substances are also covered by the Hong Kong Convention, e.g. brominated flame retardents. Generally these substances are however present in considerable smaller amounts on ships

[49] Regarding Turkey see for instance presentation “Ship recycling in Turkey from the point of legislation issues” by Mrs. Ulku Erturk, Chemical Engineer, Ministry of Environment and Forestry Republic of Turkey.
http://www.denizcilik.gov.tr/dm/dosyalar/Ministry%20of%20Environment%20and%20Forestry%20TURKEY.pdf

able. As an example none of the three countries have reported to the secretariat of Basel Convention about their generation, import and export of hazardous wastes since 2004.

In relation to PCB, one of the POP's regulated under the Stockholm Convention, only one of the Countries, Bangladesh, has prepared a National Implementation Plan (NIP) for the Stockholm Convention.

In the absence of official information, we have used the information available with various international and local experts and informal sources of information. It must be emphasised that the inadequacies of waste handling is often a matter of sensitivity to all stakeholders in the recycling nations, and strictly verifiable data are rarely available.

Informal information has also been drawn from a study carried out for the World Bank during 2009[50]. This study focused on the South Asian shipbreaking and recycling industry (SBRI) with the objective of building the knowledge base to allow effective engagement with assistance to the Government of Bangladesh, the State Government of Gujarat, India, and the Government of Pakistan to strengthen institutional and regulatory systems and improve work practices in the ship-breaking and recycling industry. The study addressed the following aspects:

- regulating and managing the inflow of hazardous and toxic waste and other chemical waste,
- identifying and adopting environmental and work safety standards and practices in line with the recommendations of the relevant international bodies, international good practices, and global conventions while preserving and strengthening the Countries' SBRIs, and
- identifying and setting up operational, financing, and/or incentive mechanisms for SBRI implementation of these standards, including thorough engagement of the customer base for SBRI products and services.

This study comprise three parts: (i) an economic and market assessment of the SBRI in the SAR, (ii) environmental audits of ships and ship recycling facilities to develop a pollution inventory and a gaps/needs assessment for compliance with the Hong Kong Convention and (iii) proposed strategies and actions to improve the environmental performance of the SBRI.

In the following subsections, EU waste management requirements and present hazardous waste management practices within main ship recycling locations in South-East Asia for each of the main hazardous waste types resulting from ship recycling are outlined. An overview of the current practices and to what extent they are EU compliant are provided in table 3.17 below.

[50] Personal communication with Mr Frank Stuer-Lauridsen project manager from Litehauz on the World Bank study

Asbestos
Asbestos may be found in thermal system insulation and on surfacing materials. When asbestos-containing materials deteriorates or is disturbed, asbestos breaks up into very fine fibres that can remain suspended in the air for a long time and possibly inhaled by workers and operators at the facility or by people living nearby. Once they are inhaled, the fibres can remain and accumulate in the lungs. Breathing high levels of asbestos fibres can lead to an increased risk of lung cancer, mesothelioma and asbestosis.

Asbestos is thus not considered a large environmental problem, but instead an occupational health problem. The Hong Kong Convention on Ship Recycling will reduce the exposure of workers to asbestos through improved working procedures and personal protection equipments. It will also significantly reduce the secondary exposure of people in the area around the ship recycling facilities from uncontrolled storage and disposal of the asbestos-containing materials.

Article 8 of Council Directive 87/217/EEC on the prevention and reduction of environmental pollution by asbestos provides that EU Member States have to ensure that transport and deposition of waste containing asbestos fibres or dust, is performed in a way that no such fibres or dust are released into the air and no liquids which may contain asbestos fibres are spilled. When asbestos waste is landfilled at sites licensed for this purpose, such waste is being treated, packaged or covered so that release of asbestos into the environment is prevented. Before removal from site, the waste will normally be double bagged and labelled to show the origin of the waste before being consigned for final disposal to a licensed asbestos site.

Use of asbestos is banned for fire-insulation in many countries of the World and the use started to be phased out during the 1980's. In 2002 an amendment of SOLAS prohibited the use of asbestos in new installations and on new ships (except in three specified cases). To reflect this it has been decided for the analysis to introduce a reduction of asbestos in the tonnage scrapped beginning in 2020 with 25% reduction per five years.

Today most asbestos generated from recycling of ships within the three South-East Asian countries are disposed of non-compliant to EU ESM requirements, e.g. by burying in the ground. In India however a hazardous waste landfill exists within Gujarat[51], which receives some of the waste asbestos. According to information from GEPIL[52] the landfill has received 103,1 MT of asbestos up till September 2009, which is around 20% of the calculated asbestos amount generated from the recycling facilities in the country in the period (see Chapter 4).

Heavy metals
Mercury, lead, cadmium and chromium occur in a number of applications in ships although the use of mercury in contacts, lamps, thermometers and heat gauges has decreased. The other metals are found in e.g. paints, batteries, plating and bearings.

[51] GEPIL Facility: http://www.gmbports.org/env_hazardous.htm
[52] http://www.gmbports.org/env_hazardous.htm

These heavy metals are problematic in the industry waste in general and in sludge from waste water treatment systems and several EU legislations address these metals both with regards to restriction of placing on the market and use in certain types of products and with regard to waste management in particular the WEEE Directive.

Waste containing more than criteria values is considered hazardous and must under EU legislation be disposed of in a separate waste stream to hazardous waste treatment facilities (the properties which render waste hazardous are laid down in Directive 91/689/EEC and are further specified by the Waste List Decision 2000/532/EC as last amended by Decision 2001/573/EC. For example the concentration criterion for lead containing waste to be hazardous is 1%). Re-use of the substances are considered acceptable.

Heavy metals present in larger components like electronic instruments and batteries are today primarily re-used from the recycling facilities in Pakistan, Bangladesh and India and are thus not considered waste and therefore not included in the following impact assessment.

The other parts of the heavy metals in larger components and the heavy metals in paints, which also constitute a considerable fraction of the substances onboard the ships, are re-processed together with the steel in the steel plants.

Heavy metals, present in paints are following the steel structure on which they are applied to the steel recycling facilities where they end up in either the re-rolling or re-melting (high temperature) process. In India (and in Bangladesh and Pakistan) outer plates (plates from the hull) are re-rolled, whereas interior steel structures are re-melted. The latter high temperature process will lead to the metals being fixated in the produced steel or ending up in the ash, which is then landfilled or otherwise disposed of in cement or roadfill. This is considered as an environmentally sound management from an EU perspective. In contrast, the re-rolling process will most often lead to an uncontrolled disposal of the paints as they burn off the steel plates at low temperatures and release to the vicinity of the mill. Therefore, it is estimated that around 75 % of the painted surfaces are interior, meaning that 75 % of the heavy metals will be treated according to EU EMS.

TBT

Tributyltin (TBT)-based antifouling paints have been successfully used for over 40 years to protect a ship's hull from bio-fouling. However, due to its high toxicity to marine organisms, the International Maritime Organization (IMO), in 1990, adopted a resolution recommending governments to adopt measures to eliminate antifouling paints containing TBT.

The International Maritime Organisation (IMO) adopted the International Convention on the Control of Harmful Antifouling Systems on Ships (AFS Convention). The AFS Convention took seven years to enter into force and did so on the 17th September 2008 banning globally both the application and presence on ships hulls of TBT-based antifoulings on new ships. In the meantime the European Union, via Regulation (EC) No. 782/2003, banned the application of

TBT-based paints on EU-flagged vessels and as of 1st January 2008. All EU flagged vessels and all other vessels visiting EU ports should be coated with TBT-free paint by this date.

TBT and paint chips containing TBT may only be disposed of by land deposition in secure landfills or via thermal treatment.

Bearing in mind that ships are dry docked and painted roughly every five years, and some ships are sand blasted and repainted, but also that some are only coated with non TBT paint we therefore introduce a 15% reduction already in 2005 followed by a repeated five year 15% reduction leaving 10% of the tonnage still with TBT paint in 2030.

TBT on ship hulls recycled in South-East Asia are today mainly re-processed together with the steel plates in the steel re-rolling mills. All TBT are on outer structures and will thus not be disposed according to EU EMS (see above description for heavy metals).

PCB

Polychlorinated Biphenyls (PCBs) are among a group of man-made chemicals that are known as Persistent Organic Pollutants (POPs). Given their extraordinary chemical stability and heat resistance, they were extensively employed as components in electrical and hydraulic equipment and lubricants. They have been used in two types of applications:

1. Closed applications: dielectric fluids in electrical equipment such as transformers, capacitors, heat transfer and hydraulic systems
2. Open applications: as industrial oils, paints, adhesives, plastics and flame retardants.

PCBs were phase out in a number of countries during the 1970's in open applications and only a few years later in closed applications. The use of the substances is now banned under the Stockholm Convention.

Pursuant the PCB Directive (96/59/EC) PCBs and equipment containing PCBs shall be phased out as soon as possible, and for large equipment before the end of 2010. The Directive call on Member States to take the necessary measures to ensure that all undertakings engaged in the decontamination and/or the disposal of PCBs, used PCBs and/or equipment containing PCBs obtain permits. Where incineration is used for disposal, the Waste Incineration Directive (2000/76/EC) shall apply. Other methods of disposing of PCBs, used PCBs and/or equipment containing PCBs, may be accepted provided they achieve equivalent environmental safety standards - compared with incineration.

A phase out profile starting 30 years after 1980, i.e. in 2010, is introduced with a 15% five-year reduction increment.

PCB generated from recycling of ships in India, Pakistan and Bangladesh is today either sold for re-use as part of its host component, which is not compliant with EU requirements, burned together with the PCB-containing waste oil or disposed of uncontrolled in other ways.

Regarding India, information exists on the availability of other incineration plants in India and in Gujarat, but the temperatures of these are too low[53] to incinerate PCB. For Bangladesh, the Stockholm Convention National Implementation Plan states that Bangladesh currently lacks environmentally sound destruction facility to destroy PCB wastes[54].

Oil and oily sludge

Waste oils including oily sludge are hazardous waste as they display some hazardous properties. They are regulated by Directive 2008/98/EC on waste. Pursuant to Article 21 and without prejudice to the obligations related to the management of hazardous waste in Articles 18 and 19, waste oils shall be collected separately, where this is technically feasible and waste oils shall be treated in accordance with Articles 4 (waste hierarchy) and 13 (protection of human health and the environment)where technically feasible and economically viable: Furthermore waste oils of different characteristics shall not be mixed nor shall waste oils be mixed with other kinds of waste or substances, if such mixing impedes their treatment.

Any discharge of waste oils into inland surface water, ground water, territorial sea water and drainage systems is prohibited; any deposit and/or discharge of waste oils harmful to the soil and any uncontrolled discharge of residues resulting from the processing of waste oils; as well as any processing of waste oils causing air pollution which exceeds the level prescribed by existing provisions.

Oil, which is here seen as oil remaining in the ship fuel tanks and other oil tanks, is today sold for re-use for energy production from the three major recycling facilities. The oil in oily sludge and waste oil is when possible reclaimed. In Bangladesh it is sometimes mixed with sand and used for energy production in e.g. brick production[55].

Ozone depleting substances (ODS)

Chlorofluorocarbons (CFCs and HCFCs) and methyl bromide depletes global ozone layer and they contribute to global warming. The EU has laid down legislation in accordance with the Montreal Protocol (1987) to control the use, production and import of ozone depleting substances.

Regulation (EC) 2037/2000 on substances that deplete the ozone layer sets requirements to protect human health and the environment by reducing emissions of ozone depleting chemicals. The Regulation bans the production, importation,

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[53] http://www.envfor.nic.in/cpcb/hpcreport/chapter_3a.htm

[54] Bangladesh National Implementation Plan (NIP). For Management of Persistent Organic Pollutants (POPs). Prepared under UNDP Project BGD/02/G31/1G/99. Department of Environment (DoE). Ministry of Environment and Forests. Government of the People's Republic of Bangladesh, January 2007.

[55] Personal communication with project manager for ongoing World Bank ship recycling study, performed by Litehauz, including inspections at all three recycling locations

exportation, placing on the market and use of ozone depleting substances for most applications although allowances exist for certain delays and exemptions.

ODS are covered by MARPOL Annex VI on air emissions. The use of ODS in new and existing installations for fire extinguishing and in refrigerant systems covered by Annex VI has therefore been reduced (although a general exemption for HCFCs is still in place). However, the historic use of CFCs as blowing agents for polyurethane foam will still lead to ODS import in scrap yards.

ODS should be collected and disposed of via thermal destruction.

Today ODS's generated from recycling of ships in India, Pakistan and Bangladesh are collection and sold for re-use, which is not considered acceptable as environmentally sound management at European level.

A phase out profile is introduced starting with an immediate 5% reduction in the first two five year periods due to MARPOL Annex VI. This is followed by a more dramatic reduction of 30% per five years beginning 2020, i.e. 30 years after 1990, the nearest decade to the entry-in-force of the Montreal Protocol.

The following table summarises the current waste management practises for the hazardous waste fractions as described in the sections above.

Table 3-11 Overview of current waste treatment practices in India, Pakistan and Bangladesh and their compliance with the EU requirements

	India	Bangladesh	Pakistan
Asbestos	Partly compliant landfilling Partly non compliant, e.g. burial	Non compliant, e.g. burial	Non compliant, e.g. burial
PCB	Either sold for reuse as part of its host equipment (non-EU compliant) or disposed of un-controlled. In a few cases stored.	Either sold for reuse as part of its host equipment (non EU compliant) or disposed of un-controlled	Either sold for reuse as part of its host equipment (non EU compliant) or disposed of un-controlled
Heavy metals	In larger components like batteries: reused (EU compliant) In paints: follows the steel plates to the steel plants (partly EU compliant and partly non-compliant)	In larger components like batteries: reused (EU compliant) In paints: follows the steel plates to the steel plants(partly EU compliant and partly non-compliant)	In larger components like batteries: reused (EU compliant) In paints: follows the steel plates to the steel plants(partly EU compliant and partly non-compliant)
Oil	Reuse (EU compliant)	Reuse (EU compliant)	Reuse (EU compliant)
Oil sludge	Partly collected and reused for energy production (EU compliant) Partly dumped/washed out to sea	Partly collected and reused for energy production or brick production (EU compliant) Partly dumped/washed out to sea	Partly collected and reused for energy production (EU compliant) Partly dumped/washed out to sea
TBT	Follows the steel plates to the steel plants (partly EU complaint and partly non-compliant)	Follows the steel plates to the steel plants (partly EU complaint and partly non-compliant)	Follows the steel plates to the steel plants (partly EU complaint and partly non-compliant)
Mercury	Reuse (non-EU compliant)	Reuse (non-EU compliant)	Reuse (non-EU compliant)
ODS	Reuse (non-EU compliant)	Reuse (non-EU compliant)	Reuse (non-EU compliant)

3.4.4 Estimated future EU ESM compliance in main ship recycling locations

Introduction

To predict the impacts of the different scenario on the hazardous waste generation in the ship recycling countries the waste management practise within these countries must be assessed for the situation after implementation of the different policy scenarios, including the entry into force of the IMO Convention.

Regulation 20 of the IMO Convention on Safe and environmentally sound management of hazardous materials specify that "ship recycling facilities authorized by a Party shall ensure safe and environmentally sound removal of any hazardous material contained in a ship certified in accordance with regulation 11 or 12. The person(s) in charge of the recycling operations and the workers shall be familiar with the requirements of this Convention relevant to their tasks and in particular actively use the Inventory of Hazardous Materials and the Ship Recycling Plan, prior to and during the removal of hazardous materials." The Convention does thus not include specific requirements for safe and environmentally sound disposal of hazardous material, wherefore implementation of the Convention will not in itself ensure improvements in the waste management and disposal in the ship recycling Countries.

India

With the available hazardous waste landfill and the incineration facilities in Gujarat, and the current waste management practises, with some of the asbestos already being correctly collected and disposed of (estimated around 20-25 %), it is assumed that, at the time of the entry into force of the Convention, India will be in a position to and actually treat all or most of the asbestos, mercury and oily sludge according to EU EMS requirements.

For PCB's, which are today not collected in a separate waste stream, it is expected that a dedicated and proper waste incineration facility will be established in Gujarat or cement kilns available in the region will be used for incineration of part of the generated PCB. Functional equipment containing PCB may however still be sold on.

ODS, which are easily collected in a separate fraction, constitute an easy source of income for the ship recyclers today and in the future when sold for topping off existing CFC dependent refrigerant systems. For that reason it is not expected that more than half of the future generated amounts of ODS will be disposed of via incineration.

It is not expected that heavy metal- and TBT-containing paints in the future will be collected separately. Instead the current management practises are expected to continue.

Bangladesh and Pakistan

Changes to the current hazardous waste disposal in Bangladesh and Pakistan, in any foreseeable future are expected to be limited.

In Pakistan the ship recycling facilities of Gadani is located relatively close to Karachi and the industrial area, Hub. Because of this the possibility of a hazardous waste landfill being constructed in Pakistan is estimated to be higher than in Bangladesh.

Waste fractions representing a direct value to the recyclers, e.g. ODS and mercury are expected to see small or no changes in the waste management practise within the two countries. Some compliant management of ODS are expected in the form of proper storage and/or incineration in cement kilns.

The following table summarises the estimated current and future waste treatment practices within the three countries, India, Pakistan and Bangladesh as described above. As described official information is absent on current waste treatment practise wherefore the information in the table is based on expert judgement and other available information, as for instance from the ongoing Divest project.

Table 3-12 Estimated future (in 5 - 10 years) waste treatment practices compared with EU ESM practise within the three countries India, Pakistan and Bangladesh

	India	Bangladesh	Pakistan
Asbestos	Mainly compliant landfilling Partly non compliant	Limited compliant Mainly non compliant	Partly compliant Partly non compliant
PCB	Partly sold for reuse as part of its host equipment (non-EU compliant) or disposed of un-controlled. Partly compliant	Partly sold for reuse as part of its host equipment (non-EU compliant) or disposed of un-controlled. Partly compliant	Partly sold for reuse as part of its host equipment (non-EU compliant) or disposed of un-controlled Partly compliant
Heavy metals	In larger components like batter-ies: reused (EU compliant) In paints: follows the steel plates to the steel plants (partly EU compliant and partly non-compliant)	In larger components like batter-ies: reused (EU compliant) In paints: follows the steel plates to the steel plants(partly EU compliant and partly non-compliant)	In larger components like batter-ies: reused (EU compliant) In paints: follows the steel plates to the steel plants(partly EU compliant and partly non-compliant)
Oil	Reuse (EU compliant)	Reuse (EU compliant)	Reuse (EU compliant)
Oil sludges	Mainly collected and reused for energy production Limited dumped/washed out to sea	Partly collected and reused for energy production Partly dumped/washed out to sea	Mainly collected and reused for energy production Limited dumped/washed out to sea
TBT	Follows the steel plates to the steel plants (partly EU complaint and partly non-compliant)	Follows the steel plates to the steel plants (partly EU complaint and partly non-compliant)	Follows the steel plates to the steel plants (partly EU complaint and partly non-compliant)
Mercury	Limited reuse (non-EU compli-ant) Mainly compliant landfilling	Mainly reuse (non-EU compli-ant) Partly compliant, e.g. landfilling, re-export etc.	Mainly reuse (non-EU compli-ant) Partly compliant, e.g. landfilling, re-export etc.
ODS	Partly incineration (compliant) Partly reuse (non-EU compliant)	Partly compliant Mainly reuse (non-EU compli-ant)	Partly compliant Mainly reuse (non-EU compli-ant)

3.4.5 Degree of compliance with the EU hazardous waste management requirements

In the following subsections, the degree of compliance with the EU hazardous waste management requirements are reviewed for ship recycling in India, Bangladesh and Pakistan for each of the main hazardous waste types regulated by the Hong Kong Convention. The compliance level is estimated in percentage using a stepped model, with steps of 25 %. The sources on which the estimations are based are indicated as well as an estimation of the associated uncertainties, which will influence the impact assessment.

Asbestos

India

A hazardous waste landfill is available in Gujarat India whereas no such facilities are available in either Bangladesh or Pakistan. Comparing information from GEPIL (the operator of the hazardous waste landfill in India) on the amounts of asbestos collected at the landfill to the estimated total generation of asbestos waste from recycling of ships at Gujarat in the same period indicates that at present around 20% of the asbestos from the ship recycling industry in India is being disposed of according to EU requirements.

Given that a hazardous waste landfill on site is available some of the asbestos already being correctly collected and disposed of, it is assumed that, at the time of the entry into force of the Convention, India will be in a position to and actually correctly dispose of most or all of the asbestos. For the impact assessment is estimated 25% correctly disposal today and 75 - 100% for the future scenario.

Pakistan

The hazardous waste generated from Karachi and the industrial area close to the ship recycling facilities of Gadani will add to the hazardous waste from the recycling yards and make establishment of a hazardous waste landfill in the region even more feasible. The intention on establishing such hazardous landfill is confirmed by key stakeholders in Pakistan[56]. However, new control and management procedures on the recycling sites, in relation to a future new hazardous landfill, can not be expected to be fully implemented. Furthermore disposal of asbestos at the landfill will constitute an additional cost for the recyclers. It is therefore unlikely that an effective collection system for asbestos will be in place at the time of entry into force of the Convention. Consequently, for the impact assessment it is estimated that 0% is correctly disposed of today and 25 - 50% in the future scenario.

Bangladesh

As regards Bangladesh, it is considered less likely that a hazardous waste landfill will be developed over the 5-10 period to come. However, some improvements of the HSE situation at the recycling sites are expected and proper storage and/or re-export of asbestos for environmentally sound management is foreseen. In general the infrastructure is less developed in Bangladesh compared to in Pakistan and the civil society in general not as well functioning in Bangladesh compared to in Pakistan. For the impact assessment is estimated 0% correctly disposal today and 0 - 25% for the future scenario.

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[56] Personal information from Frank Stuer-Lauridsen

The reduced generation of asbestos from the recycling sites in the future (25% per fifth year from 2020) will reduce the relative impacts of the uncertainties of the estimates for future EU ESM compliant waste management in the three countries.

PCB

Currently, there is no EU compliant management of PCB containing waste in any of the three countries. PCB contaminated material from recycling of ships in India, Pakistan and Bangladesh is today either sold on as part of its host component for re-use or it is burned together with the PCB-containing waste oil or disposed of uncontrolled in other ways. None of these practices are compliant with the EU requirements.

India

It is expected that India, with the focus on improving shipbreaking in Alang, will be able to dispose 50% of the PCB containing material and waste from shipbreaking in a compliant manner in the near future – basically the fraction not found in resold equipment.

Bangladesh and Pakistan

As regards Bangladesh and Pakistan, it is expected that only a fraction up to 25% of the PCB will be disposed of properly by the end of the coming decade. As dedicated incineration facilities are not to be expected the fate of this compliant PCB is judged to be via thermal treatment in cement kilns or re-export.

Heavy metals

Only waste heavy metals, primarily heavy metals in paints, are considered in the impact assessment. Heavy metals present in larger components, like electronic instruments and batteries, which are re-used in the three countries are thus not considered waste and therefore not included in the impact assessment.

Heavy metals, present in paints are following the steel structure on which they are applied to the steel recycling facilities where they end up in either the re-rolling or re-melting (high temperature) process. In the three countries outer plates (plates from the hull) are re-rolled, whereas interior steel structures are re-melted. It is estimated that around 75 % of the painted surfaces are interior.

The re-melting process is a high temperature process, which will lead to the metals being fixated in the produced steel or ending up in the ash. This is for the following impact assessment evaluated as an environmentally sound management from an EU perspective. This assumption, not based on inspections of facilities, relies on the waste ashes from the steel processing plants being correctly disposed of and sufficient stack emission filters etc. being installed.

For both the present and future situations are estimated 75% correctly disposal compared to the EU requirements. Uncertainties on these estimates are linked to the assumption that the present and future steel re-melting process is EU ESM compliant. If this is not the case the compliance percentage will be reduced relatively.

Oil

Oil, which is here seen as oil remaining in the ship fuel tanks and other oil tanks, is an asset to the ship recyclers and is today either used for energy production by the recyclers or sold for use for energy production. This is compliant with the EU requirements. There is no rationale for changing these procedures for the recyclers wherefore for both the present and future situation is estimated 100% correctly disposal compared to EU ESM.

Oil sludge

The oily part of the oil sludge, including waste oils, are whenever possible recovered for energy production. This is considered compliant with EU requirements. According to inspections on site in Bangladesh, oil sludge is sometimes mixed with sand and used in furnaces for brick production[57]. Such practice is not EU compliant.

The oil fraction of the oil sludge thus constitutes an economic asset to the ship recyclers, which provides an incentive for recovery and reuse. Based on expert judgment in all three countries around 50% of the oil sludge disposal are presently estimated EU compliant.

India

With the availability of a hazardous waste landfill near the shipbreaking sites in India and the current waste management practises being improved across the country, it is assumed that, India, at the time of the entry into force of the Convention, will be in a position to correctly dispose of most or all of the remaining oil sludge. For the impact assessment is estimated 75 - 100% compliance for the future scenario.

Pakistan

The intention on establishing a hazardous landfill in Pakistan provides improved estimates for the future EU ESM compliant waste management. An expert judgement based estimate of 75% compliance is applied for the future scenario in the impact assessment. Uncertainties on this estimate are linked to the assumption on establishment of a hazardous waste landfill. If this assumption is not fulfilled future compliance around the present compliance level of 50% will be seen in Pakistan.

Bangladesh

No changes to the present situation are reckoned for Bangladesh. 50% compliance is thus estimated for the future situation in the impact assessment.

TBT

According to our assessment no recycling sites within the three countries are today removing and collecting paint (TBT-containing or non-TBT containing) from the steel structures. TBT-containing paint is today re-processed together with the steel plates in the steel plants. All TBT are on outer structures and will thus be re-rolled, which is not in compliance with the EU requirements.

Bearing in mind that the generated TBT waste from the recycling facilities will be reduced significantly within the coming years (15% reduction already in

[57] Personal communication with project manager for ongoing World Bank ship recycling study, performed by Litehauz, including inspections at all three recycling locations

2005 followed by a repeated five year 15% reduction leaving 10% of the tonnage still with TBT paint in 2030) no dedicated procedures to correctly manage and dispose of TBT are expected introduced within any of the three countries. For both the present and future situations are thus estimated 0% correctly disposal compared to EU ESM.

Mercury

Mercury is found mainly in various electric equipments, navigational and safety equipment and thermometers, which are typically resold. Today, the waste containing mercury is not treated in an EU compliant manner.

India

It is expected that contaminated material from recycling of ships in Alang, India, will be disposed of in a compliant manner in the near future for 75-100% after the introduction of the new ESM policy of the Gujarat Maritime Board.

Bangladesh and Pakistan

In Bangladesh and Pakistan it is expected that up to 25% of the mercury waste will be disposed of properly in landfills, treatment or by re-export by the end of the next 5-10 years.

ODS

The ozone depleting substances represent a commercial value to the ship breakers and today they are resold either together with their host equipment or in sealed containers for use as topping off in existing CFC dependent refrigerant systems. It is therefore anticipated that the implementation of ESM practises in this area will be difficult in all three countries, but that improvements will be seen. The countries have therefore been assigned ranks based on a general assessment of the progression in the industry's approach toward environmental issues and the availability of proper disposal facilities: 50%, 25% and 0-25% for India, Pakistan and Bangladesh, respectively.

Table 3-13 Overview of estimated EU compliant hazardous waste management practises at present and following upgrade. Where a range is given, the range average is applied in the impact assessment calculations

		India	Bangladesh	Pakistan
Asbestos	Present	25	0	0
	Upgraded	75-100	0-25	25-50
PCB	Present	0	0	0
	Upgraded	50	25	25
Heavy metals	Present	75	75	75
	Upgraded	75	75	75
Oil	Present	100	100	100
	Upgraded	100	100	100
Oil sludges	Present	50	50	50
	Upgraded	75-100	50	75
TBT	Present	0	0	0
	Upgraded	0	0	0
Mercury	Present	0	0	0
	Upgraded	75-100	25	25
ODS	Present	0	0	0
	Upgraded	50	0-25	25

3.5. Economic impact

The economic analysis is carried out by estimating the extra cost and benefit related to the change in the different scenarios as a result of implementation of the HKC via different policy scenarios of which some are exceeding the Convention requirements.

3.5.1 Calculation

Time frame

The timeframe for the analysis is 2000 to 2030.

Geographical delimitation

The analysis focuses mostly on the cost and benefits directly related to Europe. However some benefits are also included even if they do not have direct impact on Europe, e.g. CO_2-emissions in Asia.

Discounting - Calculation rate

Costs are expressed as the cost in the year presented (2000, 2005, 2010, 2015, 2020, 2025 and 2030) by applying a calculation rate of 4% p.a.

Unit cost

The calculation is based on calculated unit costs, e.g. per ship, per death, per unit saved CO_2 etc. Details on the unit costs are described below followed by the tables including the actual unit costs.

Costs

The main costs identified and included in the economic analyses are the following costs for ships in operation:

- Establishing Inventory of Hazardous Materials (IHM)
- Issuing and checking of certificates based on the IHM
- Port state control of certificates for ships calling EU ports
- Flag-state control for EU Member State flags
- Checking of IHM certificates for ships calling European ports.

Costs for preparing ships for recycling:

- Update of the IHM's
- Issuing and checking of the Ready to recycle certificates
- Issuing and checking of ship recycling plans from EU recycling facilities
- Costs (loss of net revenue) for selling a ship for recycling at a facility with a certain minimum HSE standard.

Costs for EU recycling facilities:

- Preparation and issuing of ship recycling facility management plan and emergency preparedness and response plans for EU ship recycling facilities
- Authorisation of EU ship recycling facilities
- Issuing and checking of Statement of completion.

Comments on the most important costs are inserted below.

Inventories of Hazardous Materials (IHM)

Hazardous materials are used in shipbuilding and ship repair for technical and safety reasons and may also be contained in fuel and cargo. The convention requires all ships to have an onboard inventory of hazardous materials (IHM) after five years. The first five years is IHM's only a requirement for new ships.

The cost of establishing the IHM will be lowest for new builds as all relevant information on hazardous materials in the ship’s structure will be readily available.

Ready to recycle certificates

The cost of establishing the international ready to recycle certificate (IRRC) equals the cost of obtaining the ship's final comprehensive IHM and the cost of verifying and issuance of the IRRC by classification society.

The costs will be on the ship owner.

Requirements to the dismantling facilities

The convention requires that ship recycle facilities are to be authorised after inspection by local authorities after issuing of the required plans.

For the impact assessment these costs are only relevant for EU recycling facilities. As a result of the existing regulatory praxis in EU these costs will be very limited.

Benefits

The benefits identified are the following:

- Reduced emissions of CO_2
- Fewer accidents at the ship recycling facilities
- Fewer death directly related to work activities at recycling facilities
- Positive environmental impact due to better handling of the dismantling process e.g. waste treatment, emissions to the environment etc.

Accidents

For accidents the number of days where the worker is not able to work will be calculated as lost earning those days, which is a cost to the society. The calculations do not include medical cost related to the accidents etc., as these are not available. The effects of leaving out these costs are however estimated insignificant.

Deaths

It is expected that the extra requirements for the dismantling facilities will lead to a reduction in the relative number of fatal accidents at the recycling facilities. These deaths will be valued by using the unit cost from the Impact Assessment. There are two main approaches to value life. The Value of Statistical Life (VSL) method estimates what the willingness to pay for a life is, whereas the Value of Life Year (VOLY) method estimates the value of living one year longer. When using VSL the value of a life is the same in the entire world whereas using VOLY combined with local information of life expectancies, one will achieve variation over the world. Here the VSL method is applied.

Table 3-14 Estimates for the value of one death

Deaths	VSL €/life
median	980.000
mean	2.000.000

Source: European Commission Impact Assessment Guidelines 15 January 2009, SEC(2009) 92

As a result of the majority of accidents occur in the lower income regions in Asia, the median VSL value of 980.000 EUR is applied in the analyses.

Distribution of cost and benefits
The analyses include estimation of the distribution of the costs between the ships owners and the public administration.

The costs for the ships owners relates to the specific Convention requirements and the implications thereof as described above.

Further, one could argue that there are additional direct costs for the recycling facilities. However, they are not included in this analysis. The reason for this is the need to avoid double counting. This cost effect is namely also captured by the lower price paid for the ships when being dismantled at a facility that fulfils the higher requirements. Hence, this cost effect is already included.

The administrative costs are borne by the public authorities and consist of the costs of administrating, validating and checking of inventories and certificates.

The external costs and benefits can be in the form of for example environmental improvements or less use of child labour. These costs and benefits will not be valued (monetised) in this study. If one were to undertake a valuation of the environmental impacts, this would call for a mapping off the affected areas and the related changes that would occur as a result of the dismantling process.

3.5.2 Unit costs

The economic unit costs are reproduced in the tables beneath. The costs are categorised according to the types of activities that invoke them.

The unit costs are based on the time spent on these tasks as described in an assessment for Denmark[58] and the cost for analysis. These estimates are then scaled up to a European level through applying the relevant labour costs and number of ships.

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[58] Memo on Socio economic impact assessment of IMO Ship Recycling Convention implementation in Denmark. Prepared by Litehauz for the Danish Environmental Protection Agency

Table 3-15 Unit cost related to the Convention requirements for certificates for ship in operation

	Consequence	**Cost**	**Unit cost**[1]
Costs			
Inventory of hazardous materials (ships owners)	• *Each European flagged ship and ships calling at EU ports (cf. next page) has to have an inventory of hazardous materials.* • *NOTE: the navy fleet is more complex*	• *Cost for the ship owner to prepare the inventories*	• *1.830 euro/ new-ship 9.505 euro /existing ships* *+ 318 euro/5 year for renewal* • *NOTE: Cost for navy ships is estimated at 21.133 euro/ship (voluntary)*
Certificates (ships owners)	• *Each European flagged ship has to obtain an inventory of hazardous materials certificate*	• *Cost for the ship owner to obtain the certificate*	• *2.956 €/new-ship 2.519 €/existing ship Recertification each five years: 1.680 €/ship*
Certificates (administration, ship owners)	• *Administrative costs in relation to the checking of the existence and the correctness of the certificates as part of flag state control.*	• *Cost for checking the certificates*	• *Cost for having the certificates checked. First five years 271.024 €/year and later 542.073 €/year (total for Europe)*[59]
Certificates (administration, public)	• *Administrative costs related to the checking of the existence and the correctness of the certificates as part of flag state control.*	• *Cost for checking the certificates*	• *Cost for checking the certificates. 271.024€/year (total for Europe)*

Note it is assumed that the Danish fleet constitutes 4.1% of the European ships.

[59] Costs increase after five years as existing ships must then also certify for the materials in Table B/Appendix II

Table 3-16 Unit cost related to the Ready to Recycle Certificates

	Consequence	**Cost**	**Unit cost**
Costs			
Update of the inventory of hazardous materials just before dismantling (ship owners)	• *The inventory will need to be updated just before being shipped for dismantling*	• *Cost for the ship owner to have the update prepared (part I, II and III)*	• *Cost estimated to 769 €/ship*
Ready to recycle certificate (ship owners)	• *Each European flagged ship has to obtain a ready to recycle certificate before recycling*	• *For each ship a ready for recycle certificate should be issued*	• *First five years 3.360 €/ship* • *Later 6.719 €/ship* • *NOTE: no certificate are to be issued for navy ships*

The requirements for the dismantling facilities in terms of complying with the Convention will impose additional costs onto them. This translates into a loss for the ship owner, which is realised when he sells the ship for dismantling, as the price he obtains will be correspondingly lower to cover up for the increased costs. In general only costs for upgrade of existing South-Asian facilities from a non-compliant to a compliant Convention facility level are included in the analyses (including increased waste management costs). Administration costs to Member States in relation to Convention requirements for EU recycling facilities are very limited and are left out of the analyses.

Table 3-17 Unit cost related to the different requirements for the facilities

	Consequence	Cost	Unit costs
Costs			
Dismantling on facilities with different HSE requirements (ship owners)	• *Dismantling in more environmentally sound and safe recycling facilities*	• *Reduced income for the ship owner when having the ship dismantled*	• *Income from selling to an existing beaching facility in India, Bangladesh or Pakistan: 218 €/LDT* • *Income from selling to an upgraded beaching facility in India: 212 €/LDT* • *Income from selling to an upgraded beaching facility in Bangladesh or Pakistan: 211 €/LDT* • *Income from selling to a landing facility in Turkey: 184 €/LDT* • *Income from selling to a berthing facility in China: 170 €/LDT* • *Income from selling to an EU slipway/dock facility: 82 €/LDT*
Dismantling (administration)	• *The ship recycling plan should be validated by the national authorities*	• *Cost for having the recycling plan validated*	• *The costs are very small and further there are few facilities in Europe. The costs are not estimated*

Finally there are costs related to the requirement that ships calling European ports should have an IHM. The costs for the non-European ships owners are not included because this can be argued not to have a direct impact on the European economy. However there are some administrative costs related to the port controls that are to be carried out in Europe. These are included in the analyses.

Table 3-18 Unit cost related to the checking of ships calling European ports

	Consequence	**Cost**	**Unit cost**
Costs			
All ships calling European ports should have inventory of hazardous materials (administration)	• *Administrative costs related to the checking of the existence and the correctness of the inventories.*	• *Cost of checking the inventories*	• *32,5 €/ship calling European ports in administration*

Source: Memo on Socio economic impact assessment of IMO Ship Recycling Convention implementation in Denmark, DEPA

[1] The unit cost comes from "Memo on Socio economic impact assessment of IMO Ship Recycling Convention implementation in Denmark, DEPA", exchange rate1 euro = 7,44 DKK., 1 euro = 69,14 rupee

Benefits

Fewer accidents

It is expected that there will be fewer accidents on the improved facilities. This benefit can be estimated as the production loss that occurred prior to the improvements, and an estimate of this can be provided through calculating the total wages for the periods of absence.

The numbers of days where the works are not able to work due to accidents at work are estimated on the basis of a study carried out for the European commission[60]. The numbers of accidents in the *construction sector* are used and then divided into the number of days absent due to each accident. The days of absence for each 'period group' are calculated as the average of the group and then multiplied by the potential wage. It is assumed that the maximum period an employee can be absent due to an accident is two years. This assumption is valid if the affected workers' abilities are only temporarily affected. In that case, it is assumed that within a period of two years they are either back to work, or have found alternative employment. However, it must be noted that this method of calculation disregards more permanently disabled persons - unable to re-enter into the work force, and it disregards permanent impairments that result in lower productivity than before. For these reasons, and because this method of calculation does not consider quality of life implications, the estimates here are conservative.

The wages for different countries are listed in the Table beneath. Labour costs in Europe include all costs related to an employment. In other countries, the costs include only wages.

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[60] Statistical analysis of socio-economic costs of accidents at work in the European Union. 2004. ISBN: 92-894-8168-4

Table 3-19 Labour costs (2009)

Country	Sector /comments	Monthly wage	Yearly wage
Europe	Average labour cost	3.704 euro	44.449 euro
Turkey	Minimum wage	319 euro	3.828 euro
India	Basic metal, wage	166 euro	1.997 euro
Bangladesh	Construction, wage	60 euro	720 euro
China	Construction, wage	180 euro	2.160 euro

Note: used growth rate 2.5%, one month are 24 working days

Sources: Eurostat, ILO

Fewer death casualties

The benefits in terms of fewer death casualties are calculated by multiplying the number of saved lives as a result of the higher requirements to the recycling facilities and the value of a life. The latter was presented in the chapter on the method. Here it was described that there are different approaches to valuing life. Here, the VSL method and the mean value are used. This is the more conservative choices (lower costs), and most deaths are expected to happen outside Europe. Facilities are typically located where wages are low.

4 Impact analysis of scenario 1 - No additional action at EU level

4.1 Environmental impacts

4.1.1 General considerations

Taking no early or additional action at EU level would mean, that the current trends in ship dismantling would continue unabated, until the Ship Recycling Convention is ratified by Member States and enters into force in 2020.

Some of the main environmental concerns of the current ship recycling are primarily related to the harmful substances in the ships and the lack of containment of these during the dismantling processes, storage and transport, which allows the toxic compounds to enter the environment.

After transposition of the IMO Ship Recycling Convention into the national law of flag States and recycling States in 2020, positive effects are expected in a step by step process. Notably the obligation to carry an Inventory of Hazardous Materials (IHM) would become applicable for new ships, which are defined as ships for which the building contract is placed after that point in time or for which the delivery is 30 months later. For existing ships, the IHM requirement would become mandatory not later than five years after the Convention's entry into force.

The Ship Recycling Convention also requires that ship recycling facilities are to be authorised. This mandatory authorisation is to be given after inspection by the Party or a responsible organisation to facilities managed in compliance with the national implementation of the Convention and its Guidelines.

The possibilities for the facilities, the shipowners and other stakeholders to assess and follow the performance of the ship recycling yard are prepared for in the Convention, which states that a facility must have: "A system for (regular) monitoring of the performance of the ship recycling operations". The issue of monitoring of the facilities is addressed in the Convention guidelines based on a submission from the US regarding the Recycling Facility Management Plan. The Recycling Facility Management Plan has to be prepared by the recycling facility to specify the manner in which each ship will be recycled, depending on its particulars and its inventory.

The requirement for ship recycling facilities to obtain a permit from the competent authority is already covered under national legislation in EU 27 transposing Community legislation. A recycling facility management plan does not however exist as a legal obligation under existing national or Community law.

As strict requirements for water protection and waste management are already in place for recycling facilities in EU 27, transposition of the specific Convention requirement would not substantially alter the environmental conditions for these facilities in the EU.

The new elements of the Convention for operators, including the Recycling Facility Management Plan, could improve compliance of an operator with environmental and safety rules, as it is supposed to be ship specific and be based on details on the specific hazards related to recycling of that ship, e.g. IHM data as incorporated in the Ship Recycling Plan. The exact content of the Recycling Facility Management Plan is still being developed in the Convention guidelines.[61]

4.1.2 Materials output and management of this

Below is shown the amount of materials generated from recycling of EU-ships in the period 2000 - 2030. The amounts are calculated by multiplying the predicted recycling amounts (LDT) within the different countries with the base data set on different material amounts per LDT within ships. The calculations are done by use of the Excel-sheet model placed in Appendix A, where can also be seen the detailed results of the analyses.

The base data set on materials within ships are presented below. The base data set are split between merchant and navy vessels. The base data set for merchant vessels are primarily based on data from the 1999 Norwegian study[62] supplemented with on oily sludge provided by the Divest project in Turkey. Data for navy vessels are based on data from Clemanceau[63] supplemented with the merchant vessel data for Cu, non-ferrous and heavy metals, TBT and ODS.

[61] Guidelines for the Safe and Environmentally Sound Ship Recycling

[62] Norwegian Ministry of the Environment, 1999. Decommissioning of Ships. Environmental Protection and Ship Demolition Practices. Norwegian Ministry of the Environment and Norwegian Shipowners Association. Technical Report. Report No 99-3065 Revision No. 03.

[63] Notification for Clemanceau as provided by DG ENV.G2

		Merchant ship	Navy ship
Tonnage (LDT)		37.500	31.400
Recyclable metals			
Steel	Tons	27.750	23.236
Copper	Tons	3,75	3,14
Non-ferrous metals	Tons	3.000	2.512
Hazardous substances			
Asbestos	Tons	7,00	771
PCB	kg	0,01	122.000
Heavy metals	Tons	0,26	0,22
Oil	Tons	315	35
Oil sludges	Tons	375	312
Tri butyl tin	Tons	1,20	1,00
Mercury	kg	0,02	2.000
Ozone Depleting Substances	Tons	0,90	0,75

The following Table shows the amount of recyclable materials generated from recycling of EU-ships in the period 2000 - 2030.

Table 4-1 Amounts of recyclable materials generated from recycling of merchant EU-ships

Recyclable metals	Units	2000	2005	2010	2015	2020	2025	2030
Steel	Tons	743.718	222.912	1.968.400	1.080.400	1.228.400	1.114.792	1.362.728
Copper	Tons	101	30	266	146	166	151	184
Non-ferrous metals	Tons	80.402	24.099	212.800	116.800	132.800	120.518	147.322

None of the metals are generated in EU as all vessels are, in the context of scenario 1, assumed recycled outside Europe, given that the baseline exempt from its scope small vessels and government owned vessels, including warships, whish are the only vessels currently being recycled in Europe.

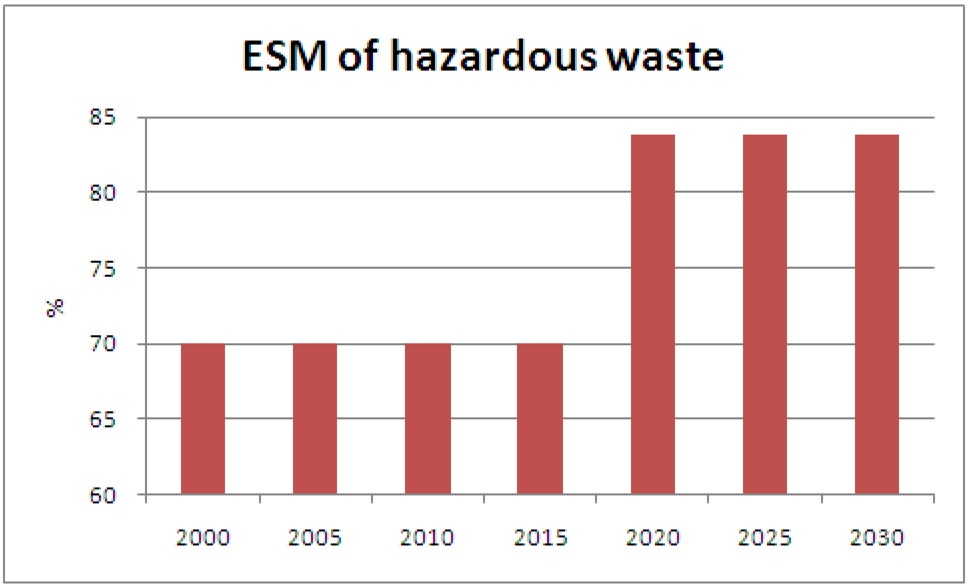
In the Table below is seen the amount of hazardous materials generated as a result of recycling of EU-ships. The total amount of materials is split between the amounts managed according to and not according to accepted environmental sound management procedures in EU as described in the previous chapter.

Table 4-2 Amounts of hazardous materials generated from recycling of EU-ships split between amounts managed according to and not according to EU accepted environmental sound management (EMS) procedures

Hazardous substances	Units	2000	2005	2010	2015	2020	2025	2030
Asbestos	t not according to ESM	120,54	36,13	319,04	175,11	108,45	73,81	60,15
	t according to ESM	67,06	20,10	177,49	97,42	201,42	137,09	111,72
PCB	kg not according to ESM	0,27	0,08	0,61	0,27	0,16	0,10	0,08
	kg according to ESM	0,11	0,03	0,24	0,11	0,18	0,12	0,09
Heavy metals	t not according to ESM	1,25	0,38	3,32	1,82	2,07	1,88	2,30
	t according to ESM	5,73	1,72	15,16	8,32	9,46	8,58	10,49
Oil	t not according to ESM	-	-	-	-	-	-	-
	t according to ESM	8.452	2.533	22.369	12.278	13.959	12.668	15.486
Oil sludges	t not according to ESM	14.883	4.461	39.390	21.620	13.274	12.047	14.726
	t according to ESM	26.578	7.966	70.344	38.610	55.206	50.101	61.243
Tri butyl tin	t not according to ESM	23,09	5,88	42,78	18,45	15,25	8,65	4,23
	t according to ESM	9,07	2,31	16,81	7,25	5,99	3,40	1,66
Mercury	kg not according to ESM	0,29	0,09	0,76	0,42	0,23	0,21	0,26
	kg according to ESM	0,11	0,03	0,30	0,16	0,43	0,39	0,48
Ozone Depleting Substances	t not according to ESM	17,32	5,19	43,54	22,64	11,69	5,30	-
	t according to ESM	6,80	2,04	17,11	8,90	12,21	5,54	-
Total	not according to ESM	15.045	4.508	39.799	21.838	13.412	12.136	14.792
Total	according to ESM	35.118	10.525	92.939	51.009	69.395	62.924	76.853

The percentages of hazardous waste not treated according to environmentally sound management procedures are shown in the figure below.

Figure 4-1 Percentage of generated hazardous waste being treated according to EMS procedures



Using the 2025 total hazardous waste generation as an average for the yearly generation in the period 2020 - 2030, the implementation of the Convention in 2020 results in an estimated extra 105.268 tons of hazardous waste being managed according to EU ESM procedures in the 10 years period compared to current practises.

The above calculated amounts of hazardous waste from the EU vessels are all exported as all vessels are assumed recycled outside Europe. The following table compares the exported hazardous waste from ships to the general shipment of hazardous waste out of EU Member States according to (COM (2009) 282 final) although it should be noted that expert of hazardous waste only takes place to OECD countries and not China, India, Pakistan or other non-OECD countries.

Table 4-3 Comparison of exported amounts of hazardous materials with ships to the general shipment of hazardous waste out of EU Member States. Comparison both presented for 2005 shipments and extrapolated yearly amounts (COM (2009) 282 final)

	2000	2005	2010	2015	2020	2025	2030
Hazardous materials on ships (1000 tons)	50,1	15,0	132,7	72,8	82,8	75,1	91,6
% compared to 2005 exports	0,89	0,27	2,36	1,30	1,48	1,34	1,63
% compared to extrapolated yearly amounts	2,27	0,27	1,18	0,50	0,46	0,35	0,37

*: based on linear regression of 2001-2005 amounts: amount = 678.8 * (year -2000) + 2208

From table 4-4 it can be seen the comparison of the amounts of hazardous materials in the scrapped EU vessels to the amount of hazardous waste exported from EU Member States. The comparisons are made to the 2005 hazardous waste exports from EU Member States as reported in (COM (2009) 282 final) and to extrapolated export amounts generated from the 2001 - 2005 exports as reported in (COM (2009) 282 final). It can be seen that the volume of hazardous materials onboard the recycled vessels make up between 0,3 - 2,4 % of the hazardous waste exports from EU Member States. The highest percentages are seen in 2010 where the recycling volumes peak as a result of the phasing out of single hulled oil tankers.

4.1.3 Atmospheric emissions

The recycling of EU vessels will lead to atmospheric emissions of CO_2 and other pollutants. These emissions will result from both the actual dismantling process, e.g. energy consumption for transportation, crane operation etc. and from the following energy consumption for reprocessing the metals generated from the recycling process. The emissions related to the reprocessing of the metals are the most significant.

The following table shows the calculated CO_2-emissions from recycling of the steel generated from recycling of the EU-flagged vessels. As all steel generated from the ship recycling industry is reused the recycling of metals from the ships replaces the need for production of new steel from virgin ore material, which is associated with considerably higher CO_2-emissions. The "savings" in CO_2-emissions from generation of steel from scrap steel compared to from virgin material are also presented in table. As no detailed information on emissions from steel generation within the different countries are available, the calculation of emissions are instead based on average emissions factors of CO_2 from primary (ore based) and secondary (scrap based) production of steel[64].

CO_2-emissions from transportation of ships to the recycling facility - the final journey of a vessel to the recycling facility, e.g. from EU to a ship recycling facility in South-East Asia - are not accounted for here, as they are deemed negligible because the final journey is most often relatively short, as the ship owner of for instance a cargo ship will often succeed in arranging a last transport of cargo from near his ships present location to a destination close to the recycling facility.

Table 4-4 CO2-emissions (1000 tons) from recycling of steel generated from EU-flagged vessels including the "savings" in CO2-emissions stemming from use of scrap instead of metal ore for generation of steel

	2000	2005	2010	2015	2020	2025	2030
Direct emissions (1,000 tons)	761	228	2.014	1.105	1.257	1.140	1.394
Savings from use of scrap metal compared to virgin material	474	142	1.254	688	782	710	868

The above figures of the direct emissions show the emission of CO_2 as a result of generation of new steel from the steel scrap from the vessels. Recycling of the steel from the ships is replacing an amount of metal ore for generation of an equivalent amount of the steel. Steel generation from metal ore is more energy consuming than scrap based steel generation wherefore the recycling of steel results in "savings" of CO_2-emissions as indicated in the lower row of the table.

4.1.4 Other environmental impacts

As mentioned above the environmental concerns of non-environmentally sound ship recycling are primarily related to the harmful substances in the ships and the lack of containment of these during the dismantling processes, storage and transport, which allows the toxic compounds to enter the environment.

Contamination level at and outside ship recycling facilities

Several studies of the contamination level at and outside ship recycling facilities have been conducted analysing collected marine water and sediment samples in the intertidal zone outside some of the ship recycling plots for pollution parameters. These studies have also analysed oil, surface water and air samples

[64] Data from the Danish Building Research Institute' PC tool (BEAT) for performing environmental assessment of products, building elements and buildings

from inside the ship recycling plots[65]. The results of these studies typically show:

- Varying contamination level in sediments, which are often not significantly different from reference studies from the same area
- Typically high concentrations of oil in surface water samples from within the breaking area
- Generally significant levels of contaminants such as heavy metals, PCB and TBT in the soil
- Normally contents of heavy metals and organic compounds are found in air-samples, but not asbestos.

The pollution of water, soil and habitats in South Asia would remain unchanged and increase when peaks of ship scrapping due to the phasing out of single hull oil tankers reach the South Asian beaches, probably around 2010 and 2015, as the scenario measures do no not enter into force before after this point in time.

4.1.5 Sub-scenario 1a - Strict interpretation

Beaching not allowed

Under some interpretation, a strict reading of the Convention would mean a ban of beaching from 2020 will have drastic consequences for the ship recycling industry. It will imply that almost 72% of the current ship recycling volume would have to be directed to other recycling locations utilising other recycling methods than beaching.

It is not expected that such ban of beaching would lead to generation of additional ship recycling in Europe, as these facilities would still not be economical competitive with for instance facilities in China and Turkey, which can still pay around the double compared to EU facilities, see Table 3-14.

An effective ban of beaching from 2020 would put a pressure on the existing recycling capacity, but with the relatively long time horizon it is expected that there will be sufficient time for additional and new capacity to develop. Such new capacity, e.g. in the form of docking facilities, could easily be in the existing low cost "beaching" countries.

For this analysis is estimated that the current recycling from 2020 is moved from the beaching facilities in South-East Asia to China, as they can pay the highest rates for the ships compared to for instance Turkey.

The strict interpretation of the Convention does not change the amounts of hazardous materials generated as a result of recycling of EU-ships. The split of hazardous waste being handled according to respectively acceptable and non-acceptable EU environmentally sound management procedures will however be changed, as can be seen by comparing the table 4-6 below with table 4-2.

[65] See for example: DNV, 2000. Decommissioning of Ships – Environmental Standards. Ship-breaking practices/on site assessment, Bangladesh – Chittagong. Report No. 2000-3158, Revision No. 01, 12. May 2000

Table 4-5 Amounts of hazardous materials generated from recycling of EU-ships split between amounts managed according to and not according to accepted environmental sound management (EMS) procedures

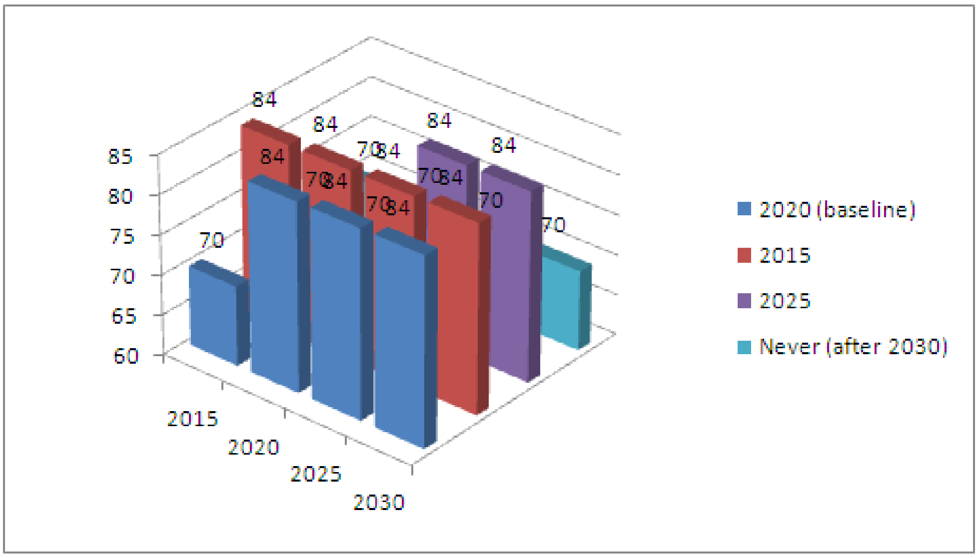
Hazardous substances	Units	2000	2005	2010	2015	2020	2025	2030
Asbestos	t not according to ESM	120,54	36,13	319,04	175,11	-	-	-
	t according to ESM	67,06	20,10	177,49	97,42	309,87	210,91	171,88
PCB	kg not according to ESM	0,27	0,08	0,61	0,27	-	-	-
	kg according to ESM	0,11	0,03	0,24	0,11	0,34	0,22	0,17
Heavy metals	t not according to ESM	1,25	0,38	3,32	1,82	-	-	-
	t according to ESM	5,73	1,72	15,16	8,32	11,53	10,46	12,79
Oil	t not according to ESM	-	-	-	-	-	-	-
	t according to ESM	8.452	2.533	22.369	12.278	13.959	12.668	15.486
Oil sludges	t not according to ESM	14.883	4.461	39.390	21.620	0	0	0
	t according to ESM	26.578	7.966	70.344	38.610	68.480	62.147	75.969
Tri butyl tin	t not according to ESM	23,09	5,88	42,78	18,45	-	-	-
	t according to ESM	9,07	2,31	16,81	7,25	21,25	12,05	5,89
Mercury	kg not according to ESM	0,29	0,09	0,76	0,42	-	-	-
	kg according to ESM	0,11	0,03	0,30	0,16	0,66	0,60	0,74
Ozone Depleting Substances	t not according to ESM	17,32	5,19	43,54	22,64	-	-	-
	t according to ESM	6,80	2,04	17,11	8,90	23,90	10,85	-
Total	not according to ESM	15.045	4.508	39.799	21.838	0	0	0
Total	according to ESM	35.118	10.525	92.939	51.009	82.806	75.060	91.645

The amounts of hazardous materials exported out of Europe with ships do not change, as all EU ships are still expected to be recycled outside Europe. Changes in CO_2-emissions from ship recycling are also not expected.

4.1.6 Variants on entry into force - Different implementation year

Different implementation years of the Convention does not changes the amount of hazardous waste generated from recycling of EU-flagged ships, but does changed the distribution of this waste between management procedures that are respectively environmentally sound and not environmentally sound according to EU standards. The detailed results of the distribution can be seen in Appendix A whereas the yearly percentage of the generated hazardous waste that is managed according to EU environmentally sound procedures can be seen in the following Table and figure.

Figure 4-2 The percentage of the hazardous waste generated from EU-flagged ships that are treated according to EU ESM procedures (2015 - 2030) for each of the HKC implementation variants



As can be seen from the modelling the implementation year of the scenario shifts the percentage of hazardous waste being managed according to EU EMS procedures from 70 - 84 %. With an average hazardous waste production from EU-flagged ships of 80.600 tonnes per year in the period 2015 - 2030 the average extra volume of hazardous waste managed according to EU EMS procedures compared to the 2020 baseline is shown in the table below.

Table 4-6 Extra estimated amount of hazardous waste managed according to EMS procedures in the period up to 2030 compared to the 2020 baseline scenario

	Extra hazardous waste amount treated according to EMS, tons
Baseline 2020	0
2015 implementation	56.420
2025 implementation	-56.420
Never (after 2030)	-112.840

4.2 Social impacts

Numerous reports indicate that the basic standards for workers' health are not adhered to at the Conventional sub-standard facilities in South-East Asia[66]. The

[66] See for example ILO Discussion Paper by Paul Bailey: Is There a decent way to break up ships? by Paul J. Bailey http://www.ilo.org/public/english/dialogue/sector/papers/shpbreak/

nature of the ship recycling work causes immediate wear-and-tear related risks, which are most often not adequately addressed, but also the long-term exposure to harmful substances is likely to have severe effects on life expectancy. However, in most facilities long-term monitoring of workers' health is non-existent.

In general systematic monitoring of health among workers engaged in ship scrapping in these regions is not very common. A very active NGO in Bangladesh Young Power in Social Action, YPSA refer a study[67] showing amongst others that 88% of the ship recycling workers suffered from some form of accidental injury from foot injury to larger accidents.

For the baseline scenario (allowing beaching under current conditions up to 2020) the estimated workload (man-years) of adults involved in recycling of EU-flagged ships including annual numbers of fatalities and non-fatal accidents amongst these is shown in the following table for each fifth year in the period 2000 - 2030.

Table 4-7 Workload (man-years) of adults involved in recycling of EU-flagged ships including numbers of fatalities and incident amongst these

	2000	2005	2010	2015	2020	2025	2030
Adult workers, man-years	3.110	932	8.231	4.518	6.058	5.498	6,721
Deaths, No.	3	1	8	4	2	2	3
Non-fatal injuries, No.	926	278	2.451	1.345	1.106	1.004	1.227

Additional social impacts of the baseline scenario are the existence of child labour in the South-East Asian recycling facilities. The number of children (man-years) involved in recycling of the EU-flagged ships are calculated and presented in the table below together with estimated numbers of accidents and deaths amongst these[68].

[67] YPSA, Ship Breaking - Towards Sustainable Management. Ship Breaking Activities and its Impact on the Coastal Zone of Chittagong, Bangladesh: Towards Sustainable Management. Dr. Md. M. Maruf Hossain and Mohammad Mahmudul Islam. Institute of Marine Sciences, University of Chittagong, Chittagong-4331, Bangladesh. Published by Advocacy & Publication Unit Young Power in Social Action (YPSA). July, 2006. ISBN : 984-32-3448-0

[68] Assuming similar incident rates for children and adults

Table 4-8 Children (man-years) involved in recycling of EU-flagged ships including numbers of fatalities and incident amongst these

	2000	2005	2010	2015	2020	2025	2030
Child workers, man-years	558	167	1.477	811	0	0	0
Fatalities, No.	0	0	1	1	0	0	0
Non-fatal injuries, No.	102	31	269	148	0	0	0

Some studies and reports are also addressing the poor working conditions of the workers at the ship recycling facilities and reports high instances of sexual transmitted diseases AIDS amongst the labourers.

4.2.1 Sub-scenario 1a - Strict interpretation

Below is shown the social impact data related to a strict interpretation of the baseline scenario.

Table 4-9 Workload (man-years) of adults involved in recycling of EU-flagged ships including numbers of fatalities and incident amongst these under a strict interpretation of the Convention not allowing beaching

	2000	2005	2010	2015	2020	2025	2030
Adult workers, man-years	3.110	932	8.231	4.518	2.281	2.070	2.530
Deaths, No.	3	1	8	4	1	1	1
Non-fatal injuries, No.	926	278	2.451	1.345	328	297	364

Table 4-10 Children (man-years) involved in recycling of EU-flagged ships including numbers of fatalities and incident amongst these under a strict interpretation of the Convention not allowing beaching

	2000	2005	2010	2015	2020	2025	2030
Child workers, man-years	558	167	1.477	811	0	0	0
Fatalities, No.	0	0	1	1	0	0	0
Non-fatal injuries, No.	102	31	269	148	0	0	0

4.2.2 Variants on entry into force - Different implementation year

Different implementation years of the Convention do changes the social impacts in terms of adult and child labour, accidents and deaths. The impacts are depicted in the following Tables and Figures. Detailed results can be seen in Appendix A.

Figure 4-3 Work load required total for different implementation year for the Convention

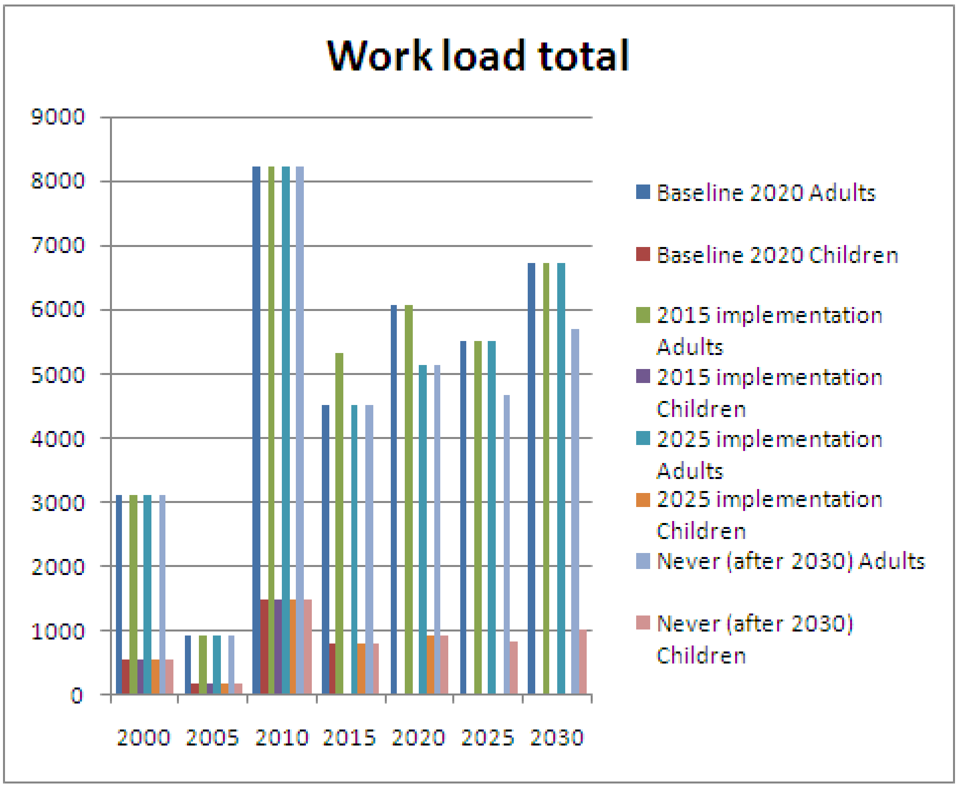


Figure 4-4 Deaths amongst adult workers for different implementation year for the Convention

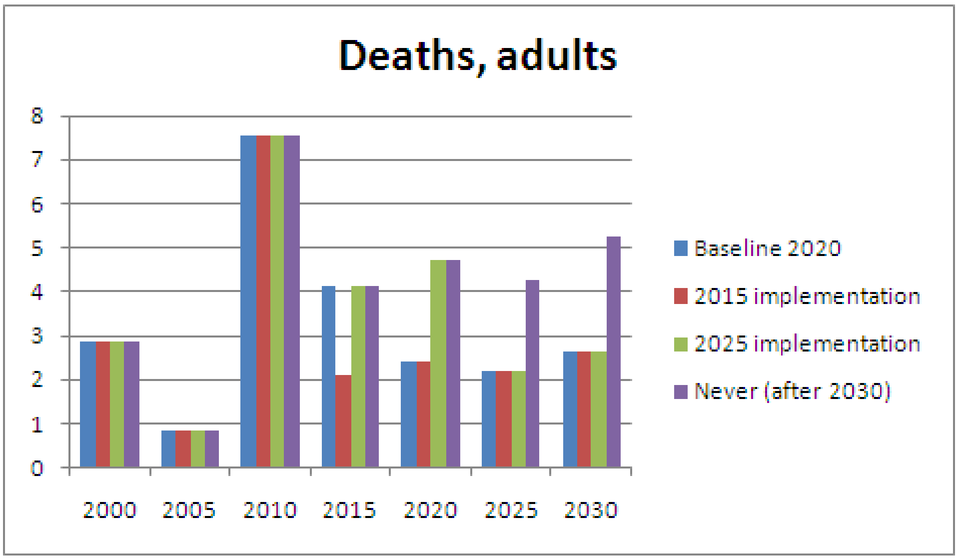


Table 4-11 Deaths amongst children workers for different implementation year for the Convention

	2000	2005	2010	2015	2020	2025	2030
Baseline 2020	0	0	1	1	0	0	0
2015 implementation	0	0	1	0	0	0	0
2025 implementation	0	0	1	1	1	0	0
Never (after 2030)	0	0	1	1	1	1	1

The following two Figures show the number of non-fatal accidents amongst adult and child workers. As can be seen from the figures the annual number of non-fatal accidents amongst adult workers is reduced by 300 - 500 the years following the introduction of the Convention. For child workers no accidents are foreseen after entry into force of the Convention in the individual scenarios, whereas before entry into force the annual number of accidents amongst children is between 145 and 180.

From the following two figures can further be seen that none of the scenarios includes measures in 2010 where far the largest numbers of accidents are expected due to the large scrap volume expected this year.

Figure 4-5 Non-fatal accidents amongst adult workers for different implementation year for the Convention

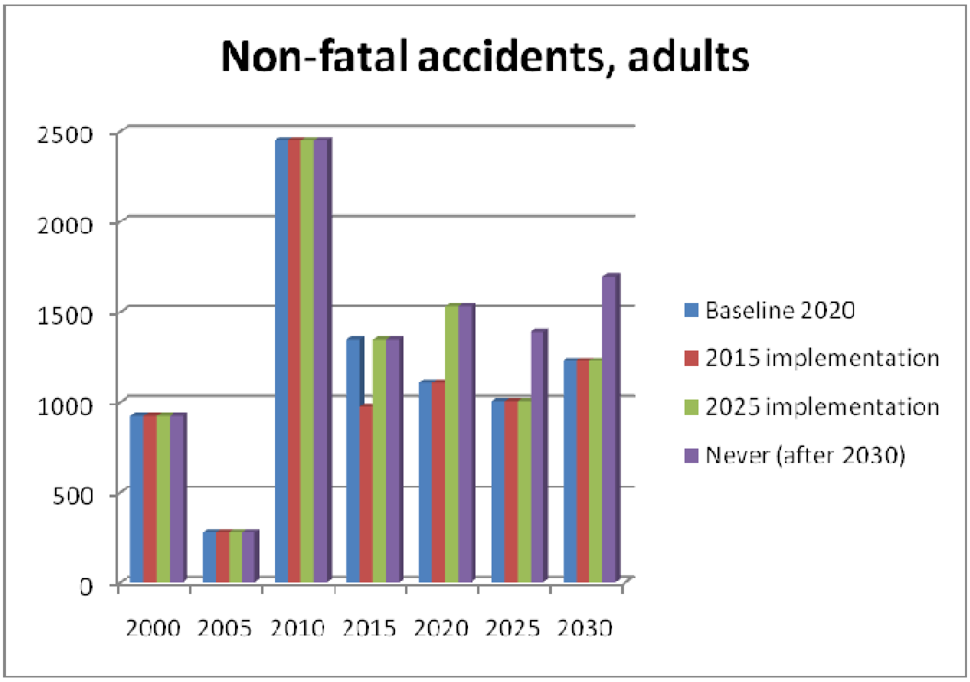
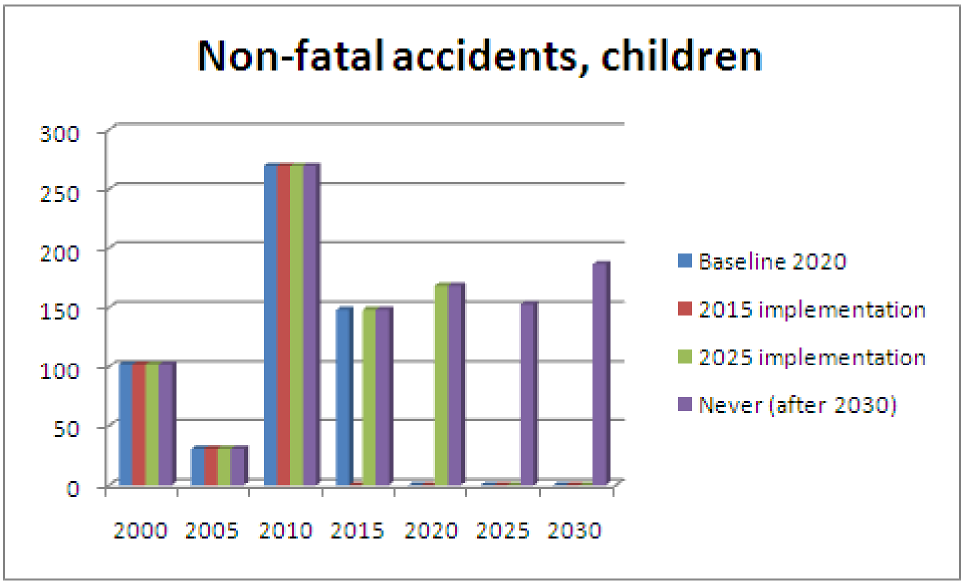


Figure 4-6 Non-fatal accidents amongst child workers for different implementation year for the Convention



4.3 Economic impacts

Costs related to implementation of the Hong Kong Convention requirements have been estimated. These costs are represented in the table below for the baseline scenario (entry into force by 2020) and for the variants thereof.

We have distinguished between costs that fall on the ships owners and those which fall on the public authorities.

Table 4-12 presents the total cost for the ships owners in the base line scenario with entry into force by 2020. As it can be seen, the ships owners would begin experiencing increasing costs as from 2020 where the requirements become binding. Also, the revenues are affected as they decline as a result of lower prices paid for ships to be dismantled.

Table 4-12 Cost and revenues for the ship owners in €

	2000	2005	2010	2015	2020	2025	2030
Costs							
Inventories new ships	-	-	-	-	465.195	513.636	763.902
Inventories existing ships	-	-	-	-	-	106.690.059	2.220.031
Certificates	-	-	-	-	751.430	52.095.411	11.728.464
Ready for recycling certificate	-	-	-	-	1.009.243	2.020.865	3.005.517
Costs for checking certificates	-	-	-	-	417.229	1.015.293	1.235.259
Revenues							
Selling ships for recycling	144.064.333	52.534.947	564.410.650	376.906.056	510.178.469	563.303.925	837.769.918
Total (+/-)	**144.064.333**	**52.534.947**	**564.410.650**	**376.906.056**	**507.535.372**	**400.968.662**	**818.816.746**

In Table 4-13 the administrative costs for the public authorities are shown. The table clearly illustrates that these administrative costs increase substantially once the requirements also come to cover existing ships.

Table 4-13 Administrative cost for Member states authorities in €

	2000	2005	2010	2015	2020	2025	2030
Additional controls in the Ports	-	-	-	-	19.112	906.816	1.300.974
Certificates	-	-	-	-	417.229	507.623	617.601
total	**-**	**-**	**-**	**-**	**436.341**	**1.414.439**	**1.918.575**

Table 4-14 Social costs in € - accidents and deaths

	2000	2005	2010	2015	2020	2025	2030
Total	3.317.854	994.449	8.781.378	4.819.854	2.460.703	2.233.125	2.729.784

4.3.1 Sub-scenario 1a - Strict interpretation

Below is shown the economic impact data related to a strict interpretation of the baseline scenario.

Table 4-15 Total costs/revenues (+/-) in € - ship owners

	2000	2005	2010	2015	2020	2025	2030
Total (+/-)	144.064.333	52.534.947	564.410.650	376.906.056	431.408.605	316.914.729	693.808.108

Table 4-16 Administrative costs in € - Member States

	2000	2005	2010	2015	2020	2025	2030
Total	-	-	-	-	436.341	1.414.439	1.918.575

Table 4-17 Social costs in € - accidents and deaths

	2000	2005	2010	2015	2020	2025	2030
Total	2.331.080	845.904	9.087.997	6.068.846	1.080.805	1.193.350	1.774.802

4.3.2 Variants on entry into force - Different implementation year

The impacts for the different implementation years of the Convention are shown in the Tables below. Detailed results can be seen in Appendix A.

Table 4-18 Total costs/revenues in € (+/-) - ship owner

	2000	2005	2010	2015	2020	2025	2030
2015 implementa-tion	144.064.333	52.534.947	564.410.650	366.855.874	395.498.886	550.031.634	818.816.746
2025 implementa-tion	144064333	52534947	564.410.650	376.906.056	521.380.813	560.338.652	604.961.824

Table 4-19 Total administrative costs in €- Member States

	2000	2005	2010	2015	2020	2025	2030
2015 implementa-tion	-	-	-	356.430	1.054.283	1.414.439	1.918.575
2025 implementa-tion	-	-	-	-	-	534.827	1.918.575

Table 4-20 Social costs in € - accidents and deaths

	2000	2005	2010	2015	2020	2025	2030
2015 implementation	2.331.080	850.059	9.132.633	2.738.444	3.788.139	4.182.602	6.220.546
2025 implementation	2.331.080	850.059	9.132.633	6.098.653	8.436.374	4.182.602	6.220.546

5 Impact analysis of Scenario 2 – Reinforced scenario

Several of the Hong Kong Convention requirements presuppose that a competent authority is nominated in the Recycling State to inter alia authorise the ship recycling facility. The authorisation requirement is closely link to the Convention requirements for Recycling Facility Management Plan and the Ship Recycling Plan.

5.1 Environmental impacts

The scope of scenario 2 is in several ways wider than for the baseline scenario, as it includes Member States navy and government owned vessels. Therefore the produced amount of recyclable materials from EU-ships covered by the scenario 2 will be larger than from the baseline scenario, which can be seen by comparing the following table, which shows the total production of metals for each fifth year in the period 2000 - 2030, by Table 5-1.

Table 5-1 Amounts of recyclable materials generated from recycling of EU-ships. Non-ferrous metals include also copper

Recyclable metals	Units	2000	2005	2010	2015	2020	2025	2030
Steel	Tons	773.318	252.512	1.998.000	1.110.000	1.258.000	1.144.392	1.392.328
Copper	Tons	105	34	270	150	170	155	188
Non-ferrous metals	Tons	83.602	27.299	216.000	120.000	136.000	123.718	150.522

5.1.1 Convention Implementation Measures

Extension of the scope of the policy scenario to include navy and government owned vessels is not expected to result in direct environmental improvement as these vessels already, also before 2014, are covered by the Waste Shipment Regulation and thus recycled in European recycling facilities. In fact the European slipway or docking facilities are in general expected environmental and social preferable to upgraded beaching facilities. Extension of the scope to include navy and government owned vessels could thus for the period 2014 - 2019 lead to that these vessels are being recycled in less favourable but compliant recycling facilities.

Dependent on the interpretation of the Convention waste management requirements, the potential shift of Member State navy and government vessels for the five year period from 2014 - 2019 from EU-ship recycling facilities to upgraded recycling facilities in South-East Asia could result in a de-facto reduction of the down-stream waste management of the waste, including hazardous waste, generated from these vessels in the period 2014 - 2019.

The total amount of hazardous waste generated from the vessels in the five year period, 2014 - 2019, is shown in Table 5-2. The calculation is based on an assumption that the hazardous waste generation from recycling of EU Member States navy and government owned vessels in 2015 represents the yearly waste generation in the period 2014 - 2019.

Table 5-2 Total amounts of hazardous materials generated from recycling of EU Member States navy and government owned vessels in the period 2014 - 2019. Compared to the baseline scenario these waste amounts could be shifted to less EHS attractive recycling facilities

Hazardous waste	Amounts of hazardous materials produced from Member States navy and government owned vessels in 2014 - 2019, tons
Asbestos	4.910
PCB	777
Heavy metals	1,4
Oil	223
Oily sludge	1.987
TBT	6,4
Mercury	12,7
ODS	4,8

The following table shows the amount of hazardous materials generated as a result of recycling of EU-flagged ships according to the policy option. The total amount of materials is split between the waste amounts respectively managed according to and not according to accepted environmental sound management procedures. It is not foreseen in the analyses that EU Members State navy and government owned vessels are redirected to Asia, but is still recycled in Europe.

Table 5-3 Amounts of hazardous materials generated from recycling of EU-flagged ships split between amounts managed according to and not according to accepted environmental sound management (EMS) procedures

Hazardous substances	Units	2000	2005	2010	2015	2020	2025	2030
Asbestos	t not according to ESM	120,54	36,13	319,04	95,38	-	-	-
	t according to ESM	1.103	1.018	1.301	1.077	982	737	491
PCB	kg not according to ESM	120,54	36,13	271,19	66,77	-	-	-
	kg according to ESM	155.399	155.399	132.090	108.780	85.470	62.160	38.850
Heavy metals	t not according to ESM	1,25	0,38	3,32	1,82	-	-	-
	t according to ESM	6,00	1,99	15,43	8,60	11,80	10,74	13,07
Oil	t not according to ESM	-	-	-	-	-	-	-
	t according to ESM	8.452	2.533	22.369	12.278	13.960	12.669	15.486
Oil sludges	t not according to ESM	14.883	4.461	39.390	11.675	0	0	0
	t according to ESM	26.975	8.363	70.741	48.952	68.878	62.544	76.366
Tri butyl tin	t not according to ESM	23,09	5,88	42,78	18,45	-	-	-
	t according to ESM	10,35	3,40	17,70	7,95	21,76	12,37	6,02
Mercury	kg not according to ESM	0,29	0,09	0,76	0,20	-	-	-
	kg according to ESM	2.548	2.548	2.548	2.548	2.548	2.548	2.548
Ozone Depleting Substances	t not according to ESM	17,32	5,19	43,54	15,42	-	-	-
	t according to ESM	7,76	3,00	18,02	16,98	24,48	11,13	-
Total	not according to ESM	15.045	4.508	39.799	11.806	0	0	0
Total	according to ESM	36.712	12.081	94.597	62.453	83.966	76.049	92.404

As can be seen from the table above no hazardous materials from EU-flagged vessels are expected managed according to non-environmentally sound procedures as of 2020 (2019, but shown in the Table) from this policy scenario.

A possible redirection of EU Member States navy and government owned vessels from EU recycling facilities to upgraded Asian facilities would further result in an extra CO_2-emission from the extra transport of these ships the long way from EU waters to the Asian ship recycling facility and transportation of the steel the opposite direction.

Estimation of the sailing distance, e.g. London - Alang, is 8.540 nautical miles (average distance of route via the Suez Channel and around the Cape)[69]. An estimate of the potential extra CO_2-emissions from sailing the EU Member State navy and government vessels to Asia for recycling and afterwards sailing the resulting steel the opposite way is 26,9 tons CO_2/year, based on the following estimates:

- Average of 25 ships transported per year
- Emission from navy vessels and government owned ships: 124,3 g CO_2 ship/nautical mile (assuming these ships are equal to smaller complex ships like refrigerated cargo; average size of 9.850 GT. [70]

69 COWI/DHI DG ENV 2007 study. Ship Dismantling and Pre-cleaning of Ships, June 2007

70 Greenhouse Gas Emissions for Shipping and Implementation Guidance for the Marine Fuel Sulphur Directive. CE Delft, Germanischer Lloyd, Marintek and Det Norske Veritas. December 2006. Publication No. 06.4103.6)

- Steel returned to Europe in three shipments in bulk carriers with an emission of 7,6 g CO_2 ship/nautical mile (assuming bulk dry carriers; average size of 81.519 GT.[71]

Under Scenario 2 all EU-flagged vessels from 2014 will be recycled in compliant recycling facilities, which is six years before the same requirement in the baseline scenario. The entry into force of the stricter environmental performance requirements for the recycling facilities already from 2014 is timely enough to include (most of) the peak of EU-flagged single-hulled tankers expected phased out around 2015.

The obligation to carry an Inventory of Hazardous Materials (IHM) would from 2014 become applicable for new EU-flagged ships, which are defined as ships for which the building contract is placed after that point in time or for which the delivery is 30 months later. For existing ships, the IHM requirement would become mandatory not later than five years after entry into force in 2014 of the EU measure, meaning no later than 2019 should all EU-flagged vessels carry an IHM.

The existence of the IHM is a key basis for developing the Ship Recycling Plan, which are very important for improving the EHS performance of ship recycling facilities. The IHM requirement for EU-flagged ships to be in place in the period 2014 - 2019 thus is valuable contribution to moving the ship recycling industry in the right direction, but the inventories will isolated seen not in themselves necessarily change the environmental impacts of the industry.

Compared to the baseline scenario the pollution of water, soil and habitats in South Asia would be reduced for the period 2014 - 2019 when recycling of ships are being moved to upgraded recycling facilities. The negative effects of various materials on board ships for the aquatic environment and for the climate would similarly be reduced in the period.

5.1.2 Flag at time of scrapping - the issue of reflagging

The above data have not taken reflagging into account, which however is potentially important when evaluating a regional regulatory approach, e.g. a different regime at EU and international level, which could lead to a reflagging of ships, whereby ships would simply change their flag and exploit the available legal loopholes outside EU for instance.

The foreseen requirement for recycling of EU flagged vessels at recycling facilities with a certain level of environmental, health and safety standards are for the period 2014 - 2020 a "regional approach", which are only targeting a part of the world's commercial fleet, which again includes the risk of evasion via reflagging of the EU-flagged vessels. The potential size of reflagging is difficult

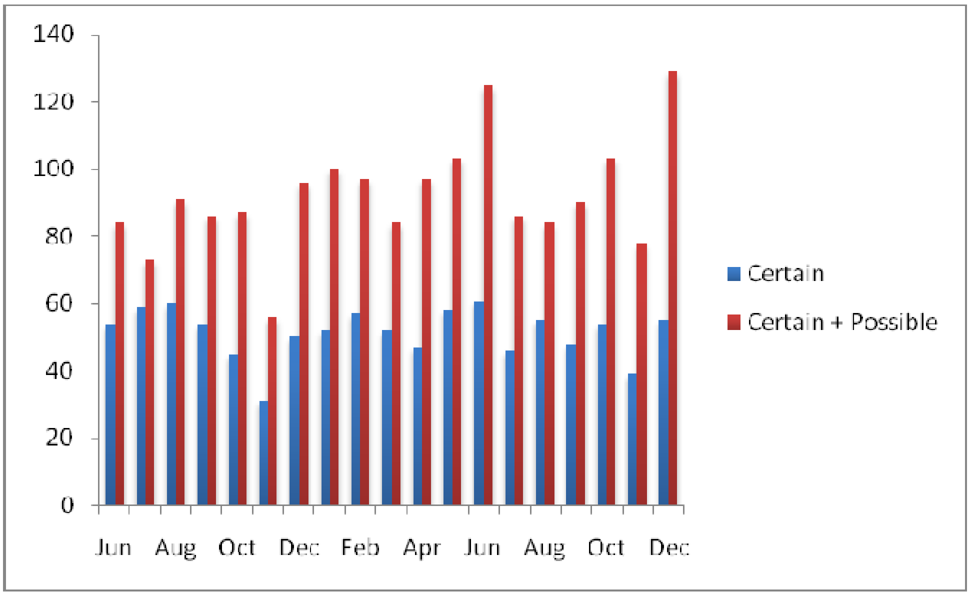
[71] Greenhouse Gas Emissions for Shipping and Implementation Guidance for the Marine Fuel Sulphur Directive. CE Delft, Germanischer Lloyd, Marintek and Det Norske Veritas. December 2006. Publication No. 06.4103.6).

to estimate. Change of flags is however a natural part of a ships life, for instance selling of a ship to a foreign owner could often be associated with a change of flag. Certain ship owners chose to sell of their ships when they reach a certain age, e.g. for economic reasons (maintenance cost, surveys and other).

As shown in previous chapter it seems that a de-facto reflagging of parts of the EU-flagged fleet could already occur today, without any specific regional environmental approaches. To get an idea of the possible extra size of an EU reflagging resulting from the regional policy option a brief assessment was performed of the consequence regarding re-flagging between 01/06/2002 and 31/12/2003 when the final version of EC Regulation 782/2003 on the prohibition of organotin compounds on ships was published and the fresh application of TBT antifouling paints was banned on EU-flagged vessels from July 1, 2003.

The data was not readily extracted from databases and did contain incomplete dataset, but EMSA presented “Certain” and “Certain + Possible” categories to maximize the information value. From the data presented by EMSA on ships leaving the European registries (EU 27 plus Norway and Iceland) during the period, there appeared to be no correlation with the AFS regulation when looking at the “Certain” category, however, when including the “Possible” it appears that whereas the normal monthly exit numbers 80-100 vessels it does reach 120 around the time of the new AFS regulation in mid 2003. These extra 20 - 40 vessels equalling around 33% of the vessels may be taken as an indication of a reaction exclusively on new environmental regulation.

Figure 5-1 Number of vessels deregistered from European registries June 2002 and December 2003



Even though highly indicative the above analyses of the period around the entry into force of the AFC could indicate a potential reflagging of around 1/3 of the EU-flagged fleet in the period 2014 - 2020.

5.1.3 EU Recycling Facilities

Under scenario 2 EU ship recycling facilities shall be authorised subject to an inspection by the Member State or a responsible organisation to facilities managed in compliance with the national implementation of the Convention and its Guidelines. The requirement for ship recycling facilities to obtain a permit from the competent authority is already covered under EU legislation. A recycling facility management plan does not however exist as a legal obligation under existing Community law.

As strict requirements for water protection and waste management are already in place for EU recycling facilities, transposition of the specific Convention requirement would not substantially alter the environmental conditions for these facilities in the EU.

The new element of the Convention policy option for EU operators, the Recycling Facility Management Plan, could improve compliance of an operator with environmental and safety rules, as it is supposed to be ship specific and be based on details on the specific hazards related to recycling of that ship, e.g. IHM data as incorporated in the Ship Recycling Plan. The exact content of the Recycling Facility Management Plan is however still being developed in the Convention guidelines[72] and is not expected to explicitly alter e.g. the waste management from EU facilities.

5.1.4 Measures targeting ships at risk

The table below shows that the introduction of ships at risk does not influence the fact that no hazardous waste is expected managed to non-environmentally sound procedures as of 2020 (2019, but not shown in the Table), as also these ships are assumed treated at EU ESM compliant facilities.

[72] Guidelines for the Safe and Environmentally Sound Ship Recycling

Table 5-4 Amounts of hazardous materials generated from recycling of EU-flagged ships and "at risk" ships, which has been visiting EU ports, split between amounts managed according to and not according to accepted environmental sound management (EMS) procedures

Hazardous substances	Units	2000	2005	2010	2015	2020	2025	2030
Asbestos	t not according to ESM	241,09	72,26	638,09	190,77	-	-	-
	t according to ESM	1.116	1.022	1.337	1.336	1.602	1.158	835
PCB	kg not according to ESM	0,54	0,16	1,21	0,35	-	-	-
	kg according to ESM	155.399	155.399	132.090	108.780	85.470	62.160	38.850
Heavy metals	t not according to ESM	2,51	0,75	6,63	3,64	-	-	-
	t according to ESM	11,73	3,71	30,59	16,91	23,33	21,20	25,85
Oil	t not according to ESM	-	-	-	-	-	-	-
	t according to ESM	16.947,72	5.110,90	44.782,19	24.599,81	27.963,54	25.381,46	31.016,53
Oil sludges	t not according to ESM	29.765	8.921	78.780	23.350	0	0	0
	t according to ESM	53.553	16.330	141.085	97.507	137.358	124.692	152.335
Tri butyl tin	t not according to ESM	46,18	11,76	85,55	36,90	-	-	-
	t according to ESM	19,42	5,71	34,51	15,20	43,01	24,42	11,91
Mercury	kg not according to ESM	0,58	0,17	1,53	0,41	-	-	-
	kg according to ESM	2.547,75	2.547,60	2.548,13	2.548,29	2.548,86	2.548,73	2.549,00
Ozone Depleting Substances	t not according to ESM	34,63	10,38	87,08	30,85	-	-	-
	t according to ESM	14,57	5,04	35,13	33,09	48,38	21,98	-
Total	not according to ESM	30.090	9.017	79.598	23.612	0	0	0
Total	according to ESM	71.821	22.635	187.439	123.620	167.126	151.364	184.266

A potential impact of the "at risk" scenario is that all such ships are redirected from sailing on EU, so that these do not enter EU ports from the date they fall under the criteria of the "at risk" model. The maximum risk is that all such ships are redirected from sailing on EU, which would in fact the result in a redirection of old and in some respects "more hazardous" ships away from European waters. The risk and potential for such redirection of ships will depend on the proposed policy measures of the "at risk" scenario, especially the extent of perceived economic and administrative burdens for the ship owners.

5.2 Social impacts

As a result of the wider scope of application of a new EU measure foreseen under his scenario more vessels are recycled under this option and thus potentially more accidents occur as a result of recycling of the covered ships. The estimated annual deaths caused by recycling of EU flagged vessels under the scenario 2 are shown in the following tables for each fifth year in the period 2000 - 2030. The two tables are without and including ships at risk, respectively.

Table 5-5 Deaths amongst recycling workers caused by recycling of EU-flagged vessels (without ships at risk)

	2000	2005	2010	2015	2020	2025	2030
Deaths, No.	3	1	8	2	1	1	1

Table 5-6 Deaths amongst recycling workers caused by recycling of EU-flagged vessels (including ships at risk)

	2000	2005	2010	2015	2020	2025	2030
Deaths, No.	6	2	15	4	1	1	1

The estimated annual non-fatal accidents caused by recycling of EU flagged vessels according to Scenario 2 are shown in the following tables for the period 2000 - 2030, respectively without and with ships at risk.

Table 5-7 Non-fatal injuries amongst recycling workers caused by recycling of EU-flagged vessels (without ships at risk)

	2000	2005	2010	2015	2020	2025	2030
Non-fatal injuries, No.	928	279	2.452	975	275	249	305

Table 5-8 Non-fatal injuries amongst recycling workers caused by recycling of EU-flagged vessels (including ships at risk)

	2000	2005	2010	2015	2020	2025	2030
Non-fatal injuries, No.	1.854	557	4.903	1.948	548	497	607

Additional social impacts of the baseline scenario are the existence of child labour in the South-East Asian recycling facilities. The number of children (man-years) involved in recycling of the EU-flagged ships are calculated and presented in the table below together with estimated numbers of accidents and deaths amongst these[73].

[73] Assuming similar incident rates for children and adults

Table 5-9 Children (man-years) involved in recycling of EU-flagged ships including numbers of fatalities and incident amongst these (without ships at risk)

	2000	2005	2010	2015	2020	2025	2030
Child workers, man-years	558	167	1.477	0	0	0	0
Fatalities, No.	0	0	1	0	0	0	0
Non-fatal injuries, No.	102	31	269	0	0	0	0

Table 5-10 Children (man-years) involved in recycling of EU-flagged ships including numbers of fatalities and incident amongst these (including ships at risk)

	2000	2005	2010	2015	2020	2025	2030
Child workers, man-years	1.116	335	2.954	0	0	0	0
Fatalities, No.	1	0	2	0	0	0	0
Non-fatal injuries, No.	204	61	539	0	0	0	0

5.3 Economic impacts

In Scenario 2 the application of the Convention requirements will be accelerated by introducing measure effective from 2014. This accelerated implementation has significant positive impact on safety conditions and on the environment.

The cost of having the convention implemented by 2014 is estimated by applying assumptions and unit costs similar to those that were applied in chapter 4.

Table 5-11 and Table 5-12 show the total costs and revenues for the ships owners. As can be seen, the additional costs begin to materialise in 2015.

Table 5-11 Cost and revenues (+/-) for the ship owners scenario 2 (excluding ships at risk), €

	2000	2005	2010	2015	2020	2025	2030
Costs							
Inventories new ships				394.432	535.935	599.702	868.614
Inventories existing ships				9.179.533	1.087.093	1.547.425	2.220.031
Certificates				571.384	8.640.495	8.198.777	11.757.302
Ready for recycling certificate				1.238.943	1.628.960	2.822.237	3.980.510
Checking certificates				342.932	834.496	1.015.293	1.235.259
Revenues							
Selling ships for recycling	146.357.575	55.325.028	567.805.210	372.937.886	437.322.792	483.427.102	717.319.429
Total (+/-)	146.357.575	55.325.028	567.805.210	361.210.661	424.595.813	469.243.669	697.257.713

Table 5-12 Cost and revenues for the ship owners scenario 2 (including ships at risk), €

	2000	2005	2010	2015	2020	2025	2030
Costs							
Inventories new ships	-	-	-	394.432	535.935	599.702	868.614
Inventories existing ships	-	-	-	9.179.533	1.087.093	1.547.425	2.220.031
Certificates	-	-	-	571.384	8.640.495	8.198.777	11.757.302
Ready for recycling certificate	-	-	-	1.238.943	1.628.960	2.822.237	3.980.510
Checking certificates	-	-	-	342.932	834.496	1.015.293	1.235.259
Revenues							
Selling ships for recycling	146.357.576	55.325.028	567.805.210	372.937.886	437.322.792	483.427.102	717.319.429
Total (+/-)	146.357.576	55.325.028	567.805.210	361.210.661	424.595.813	469.243.669	697.257.713

In Table 5-13 the administrative costs for the public authorities are shown. As can be seen they increase quite substantially compared to the baseline.

Table 5-13 Administrative cost for public authorities scenario 2 in €

	2000	2005	2010	2015	2020	2025	2030
Additional controls in the Ports	-	-	-	456.679	732.613	906.816	1.300.974
Certificates	-	-	-	342.932	417.229	507.623	617.601
Total	-	-	-	799.611	1.149.842	1.414.439	1.918.575[74]

Table 5-14 provides an overview of the social costs related to accidents and deaths. The table includes costs for two variant scenarios: with and without ships at risk.

Table 5-14 Social costs scenario 2 - accidents and deaths

	2000	2005	2010	2015	2020	2025	2030
Excluding ships at risk	2.337.860	858.308	9.142.668	2.750.654	982.565	1.086.552	1.611.076
Including ships at risk	4.668.941	1.708.367	18.275.301	5.489.099	1.950.274	2.155.030	3.200.163

The scenario 2 an additional 40.000 LDT each year (navy and government vessels) compared to the baseline. With the inclusion of the ships at risk the amount of ships (LDT/year) almost doubles compared to the baseline.

[74] Costs equal scenario 1, as all merchant ships above 500 GT will be covered by the inventory requirements in 2030 in both scenarios

6 Comparative impact analysis of scenario 1 and 2 – key figures

This chapter includes comparative impact analysis of the different policy scenarios compared to the baseline. The results are presented in Tables and Figures. The detailed results used to establish the comparisons can be found in Appendix A.

6.1 Environmental impacts

Below is shown the results of the analyses of hazardous waste treatment compared to the baseline scenario. It should be noted, that the total volume of hazardous waste generated in the two maximum scenarios are larger than in the other scenarios as the scope (number of ships included) for these two maximum scenarios are larger than for the other scenarios. The maximum at risk scenario is compared to twice the baseline two counter for the extra number of "at risk" ships.

Table 6-1 Extra amount of hazardous waste treated according to ESM procedures compared to the 2020 baseline

	2000	2005	2010	2015	2020	2025	2030
Baseline	35.118	10.525	92.939	51.009	69.395	62.924	76.853
Strict baseline	0	0	0	0	13.412	12.136	14.792
2015 implementation	0	0	0	10.032	0	0	0
2025 implementation	0	0	0	0	-11.404	0	0
Current practise	0	0	0	0	-11.404	-10.326	-12.594
Maximum (excl at risk)	1.594	1.556	1.658	11.443	14.571	13.125	15.551
Maximum (incl at risk)	1.585	1.584	1.561	21.602	28.337	25.517	30.560

The result of the analyses of the metal generation in EU and outside EU (primarily Asia) for the scenario 1 (baseline including sub-scenarios) and scenario 2 is shown in the following table. Inclusion of navy ships and other government owned vessels in scenario 2 however introduce a risk these being shifted from recycling in EU to outside EU (not shown in table).

Table 6-2 Metal waste being generated from recycling of EU vessels

		2000	2005	2010	2015	2020	2025	2030
Scenario 1*	EU	7.028	2.107	18.601	10.210	11.608	10.535	12.878
	Non-EU	736.689	220.805	1.949.799	1.070.190	1.216.792	1.104.257	1.349.850
	Total	743.718	222.912	1.968.400	1.080.400	1.228.400	1.114.792	1.362.728
Maximum (excl at risk)	EU	38.125	35.907	48.951	40.959	42.143	41.198	43.441
	Non-EU	736.410	220.526	1.949.519	1.069.911	1.216.512	1.103.977	1.349.570
	Total	774.534	256.433	1.998.470	1.110.870	1.258.655	1.145.175	1.393.011
Maximum (incl at risk)	EU	45.394	38.306	67.732	51.393	54.094	52.070	56.529
	Non-EU	1.502.699	470.931	3.928.918	2.169.701	2.462.904	2.237.834	2.729.020
	Total	1.548.093	509.237	3.996.650	2.221.094	2.516.998	2.289.904	2.785.548

*: The same for baseline, strict baseline, 2015 implementation, 2025 implementation and current practise

6.2 Social impacts

In the following two tables are shown the results of the analyses of deaths as a result of accidents in the ship recycling facilities. The relative number of deaths compared to the baseline scenario is shown.

Table 6-3 Saved lives amongst adult ship recycling workers compared to the 2020 baseline (actual death numbers shown for baseline)

	2000	2005	2010	2015	2020	2025	2030
Baseline	3,0	0,9	7,9	4,3	2,4	2,2	2,7
Strict baseline	0,0	0,0	0,0	0,0	1,7	1,5	1,9
2015 implementation	0,0	0,0	0,0	2,2	0,0	0,0	0,0
2025 implementation	0,0	0,0	0,0	0,0	-2,5	0,0	0,0
Current practise	0,0	0,0	0,0	0,0	-2,5	-2,3	-2,8
Maximum (excl at risk)	0,0	0,0	0,0	2,2	1,8	1,6	2,0
Maximum (incl at risk)	-3,0	-0,9	-7,9	0,1	1,2	1,1	1,3

Table 6-4 Saved lives amongst child ship recycling workers compared to the 2020 baseline (actual death numbers shown for baseline)

	2000	2005	2010	2015	2020	2025	2030
Baseline	0,3	0,1	0,9	0,5	0,0	0,0	0,0
Strict baseline	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2015 implementation	0,0	0,0	0,0	0,5	0,0	0,0	0,0
2025 implementation	0,0	0,0	0,0	0,0	-0,5	0,0	0,0
Current practise	0,0	0,0	0,0	0,0	-0,5	-0,5	-0,6
Maximum (excl at risk)	0,0	0,0	0,0	0,5	0,0	0,0	0,0
Maximum (incl at risk)	-0,3	-0,1	-0,9	0,5	0,0	0,0	0,0

6.3 Economic impacts

In the following two figures are shown illustrations of the results of the cost and revenues for the different scenarios compared to the baseline.

Figure 6-1 Cost and revenue (+/-) to the ships owners compared to baseline in €

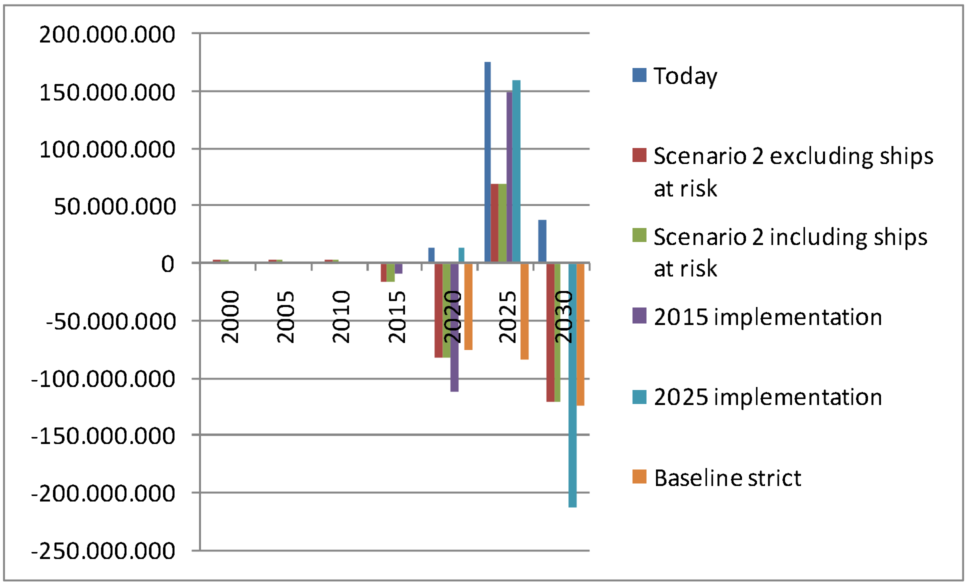
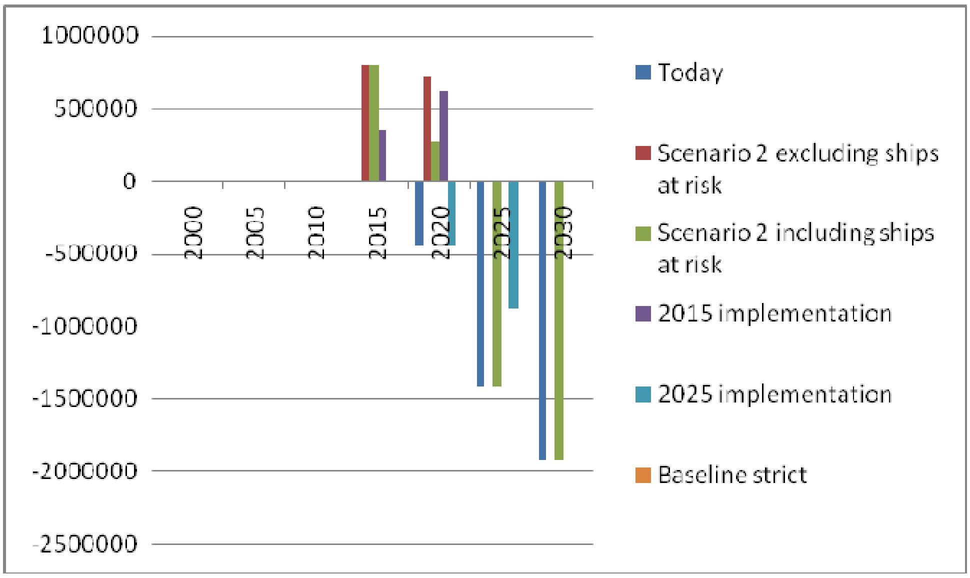
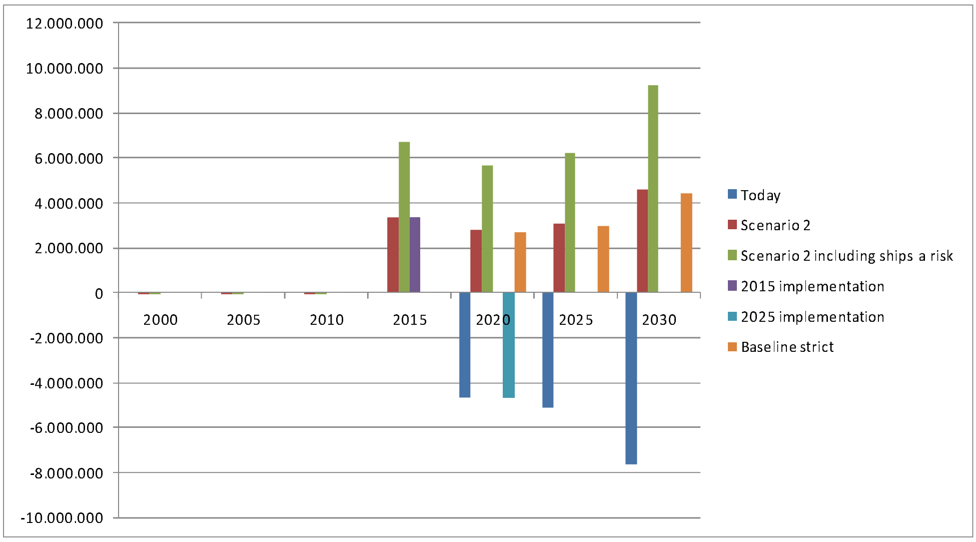


Figure 6-2 Administrative cost for the public authorities compared to baseline in €



In the figure beneath are shown the benefits in the different scenarios compared to the baseline due to reduced number of accidents and deaths. It should be noted that the scenario 2 including ships at risk are compared to twice the baseline to equal the number of ships for the comparison.

Figure 6-3 Benefits from saved lives and reduced number of accidents compared to baseline in €



In the table beneath is represented the overall cost-benefit result for the different scenarios compared to the baseline. The cost includes are the sum of the cost for the ships owners and the administrative costs for Members States. The benefits included are from fewer accidents and deaths. A positive result means that the addition costs minus the benefits are higher than compared to the baseline scenario. So it can be concluded, that the society will experiences additional costs by choosing the never enter into force scenario compared to the baseline scenario including the entry into force of Hong Kong Convention.

Table 6-5 Cost-benefit results compared to the baseline scenario in €

	2000	2005	2010	2015	2020	2025	2030
Never enters into force	0	0	0	0	18.057.335	178.421.942	43.063.015
Scenario 2 (ekskl. ships at risk)	2.300.023	2.798.330	3.404.596	-18.243.782	-85.031.632	65.178.957	-126.168.502
Scenario 2 (incl. ships at risk)	2.300.023	2.798.330	3.404.596	-21.603.990	-88.288.401	60.650.395	-132.718.536
2015 implementation	0	0	0	-13.053.961	-111.418.543	149.062.972	0
2025 implementation	0	0	0	0	18.057.335	158.490.379	-213.854.922
Baseline strict	0	-4.155	-44.635	-29.807	-78.834.101	-87.043.184	-129.454.381

Appendix A Excel sheet/model on data and scenarios

Appendix B Results of the analysis assuming only 50 % compliance (except for waste oil) with EU ESM requirements for hazardous waste management in China