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SHIP BREAKING AND RECYCLING INDUSTRY IN BANGLADESH AND PAKISTAN

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Acronyms and Abbreviations

BDA	Balochistan Development Authority
BEPA	Balochistan Environmental Protection Agency
DOE	Department of Environment (Bangladesh)
DWT	Dead Weight Tonnage
EHS	Environment, Health, and Safety
EU	European Union
GEF	Global Environment Facility
GEPIL	Gujarat Environment Protection Infrastructure Ltd
GMB	Gujarat Maritime Board
GT	Gross Tonnage
HKC	Hong Kong Convention
IFC	International Finance Corporation
IHM	Inventory of Hazardous Materials
ILO	International Labour Organization
ISO	International Organization for Standardization
IMO	International Maritime Organization
LDT	Light displacement tons
MEPC	Marine Environment Protection Committee
MoE	Ministry of Environment (Pakistan)
MoEF	Ministry of Environment and Forest (Bangladesh)
MS	Mild Steel
NIP	National Implementation Plan
NOC	No Objection Certificate
ODS	Ozone-Depleting Substance
OHSAS	Occupation Health and Safety Assessment Series
PCB	Polychlorinated Biphenyl
PPE	Personal Protective Equipment
SBRI	Ship Breaking and Recycling Industry
TBT	Tributyltin
UNIDO	United Nations Industrial Development Organization

Glossary

Ballast	Seawater taken into a vessel's tanks in order to submerge the vessel to proper trim
Basel Convention	The Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
Dead weight tonnage	The lifting or carrying capacity of a ship when fully loaded. The deadweight is the difference, in tons[1], between the displacement and the lightweight. It includes cargo, bunkers, water (potable, boiler, ballast), stores, passengers, and crew.
Decommission	The decision and process of taking a ship out of service; often used regarding naval vessels
Demolition	The process of taking a ship apart; mostly used for on shore operations
Dismantling	The process of taking a ship apart; term preferred by the Basel Convention and used in its guidelines and by the European Commission (DG Environment)
Displacement	Displacement is a measure of the weight of a navy vessel without monitions, fuel, and crew
Environmentally sound management	Specifically referring to the Basel Convention Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships
Displacement tonnage	Expressed in tons, the weight of water displaced by the vessel, which in turn is the weight of the vessel at that time
Gas free certificate (for hot work)	A certificate stating that the air in a tanker's (empty) cargo tanks is safe
Gross tonnage	The internal capacity of a vessel measured in units of 100 cubic feet
Hong Kong Convention	International Convention for the Safe and Environmentally Sound Recycling of Ships adopted in Hong Kong in May 2009
Inventory of Hazardous Materials	A list of hazardous materials generated by the shipowner under the Hong Kong Convention
International Labour Organization	The U.N. agency seeking the promotion of social justice and internationally recognized human and labor rights
International Organization for Standardization	The organization that has developed the widespread environmental standard ISO14000, often referred to as ISO 14001
International Maritime Organization	The U.N. agency responsible for improving maritime safety and preventing pollution from ships
Light displacement tons (or lightweight)	Expressed in tons, the displacement without cargo, fuel, lubricating oil, ballast water, fresh water and feed water, consumable stores, and passengers and crew and their effects, but including liquids in piping
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978
Marine Environment Protection Comm.	IMO's senior technical body on marine pollution related matters
Occupation Health and Safety Assessment Series	OHSAS 18000 is an Occupation Health and Safety Assessment Series, often referred to as OHSAS 18001
Panamax	The largest acceptable size of ship to transit the Panama Canal; applied to both freighters and tankers; lengths are restricted to a maximum of 275 meters, and widths to slightly more than 32 meters. The average size about is 65,000 DWT but may go up to at least 80,000 DWT.

[1] Note: Unless otherwise stated, ton (t) is a metric ton of 1,000 kilograms.

Recycling	The process of taking a ship apart; term preferred by the shipping industry and IMO. When procedures to safeguard the environment and workers' health and safety are applied, known as "green recycling."
Reefer	Vessel designed to transport cooled cargo, typically food stuffs.
Roll on–roll off (Ro-Ro)	A vessel allowing trucks to drive containers and other cargos directly onto one or more decks
South Asia	Geographical area, but in particular the three countries involved in SBRI: Bangladesh, India, and Pakistan
Scrapping	The process of taking a ship apart; the term preferred in the U.S. Environmental Protection Agency guideline and often used in the reused metal business
Ship breaking and recycling industry	In this study, an industry that converts, through the use of land, infrastructure, machinery, and labor and the consumption of utilities, imported end-of-life ships into steel and other recyclable items, which are sold in local markets
Ship breaking	The process of taking a ship apart; the term preferred by ILO, the EU, and many national ship breakers' associations
Ship Recycling Convention	The International Convention for the Safe and Environmentally Sound Recycling of Ships adopted in Hong Kong in May 2009, now referred to as the Hong Kong Convention

Executive Summary

The ship breaking and recycling industry (SBRI) converts end-of-life ships into steel and other recyclable items. Ship recycling offers the most environmentally sustainable way of disposing of old vessels, with virtually every part of the hull and machine complex being reused or recycled as scrap metal. Although the industry is beneficial from a life-cycle assessment point of view, over the years it has gravitated toward countries with low labor costs, weak regulations on occupational safety, and limited environmental enforcement. The “global shift” in the industry to countries with comparatively weaker regulatory systems is of particular concern as ships contain many hazards that can have significant detrimental effects on humans and the environment if not dealt with properly.

Currently, the global center of the ship breaking and recycling industry is located in South Asia, specifically Bangladesh, India, and Pakistan. These three countries account for 70–80 percent of the international market for ship breaking of ocean-going vessels, with China and Turkey accounting for most of the rest. Only about 5 percent of the global volume of such vessels is scrapped outside these five countries. This study focuses on the SBRI in Bangladesh and Pakistan to get a better understanding of the economics of the industry and the environmental impacts arising out of such activity and to explore possible ways in which such environmental effects may be mitigated.

The ship breaking and recycling industry plays a significant economic role in Bangladesh and Pakistan, supplying a substantial quantity of re-rollable scrap steel for the iron and steel industries. SBRI provides more than half of Bangladesh’s steel supply, for example, making it a strategic industry in that country. The industry also creates hundreds of thousands of direct and indirect jobs for some of the poorest and most marginalized segments of the population in those countries. The work force in each country varies with the volume of ship breaking but may range from 8,000–22,000 workers in the ship recycling yards to 200,000 in the supply chain, shops, and re-rolling mills—with dependents in extended families estimated to reach over 500,000 in Bangladesh, although fewer in Pakistan.

The SBRI also has a major social impact in that region. Most workers in the ship breaking yards are migrant workers from poorer regions of each country. The percentage of such migrant labor is higher in Bangladesh compared to Pakistan. A major reason for employment of migrant labor is the hazardous nature of the job as well as variations in employment levels depending on the extent of ship breaking work being done.

> The ship breaking and recycling industry in South Asia (Bangladesh, India and Pakistan) has grown over the past three decades and accounts for close to 70% of the global ship breaking industry.
>
> The industry provides great advantages: it’s probably the most environmentally sustainable way of disposing of old vessels, it creates jobs and supply a substantial quantity of scrap steel for the iron and steel industries (e.g, it contributed to about 50% of Bangladesh’s steel production). However, the hazardous waste and associated occupational health hazards pose a significant national and global concern.
>
> This study contributes to reducing the knowledge gap on the SBRI industry by focusing on the issues involved in two countries in South Asia, Bangladesh and Pakistan.
>
> - It assessed the productivity, competitiveness and growth potential of the industry in Bangladesh and Pakistan;
> - It undertook environmental audits of hazardous waste materials present in ships scheduled for dismantling and established a pollution inventory as well as projections of hazardous materials till 2030.
> - It provides a plan of action that enables the 2 countries to comply with the newly signed Hong Kong Convention without jeopardizing the future of the industry in South Asia.

Working conditions have historically been poor for the majority of these workers, with limited use of personal protective equipment, frequent exposure to hazardous materials, and unsafe conditions. Accidents causing fatalities and injuries are frequently reported in the local media. A wealth of reports from nongovernmental organizations, academia, and other interested entities complement the limited monitoring data from the relevant authorities. Mechanization of some of the hazardous works may minimize such accidents. Among the three countries, Pakistan uses the highest degree of mechanization in the yards.

Environmental protection is limited in most yards and the sound management of asbestos, polychlorinated biphenyls (PCBs), ozone-depleting substances (ODS), and a range of heavy metals is virtually nonexistent. Of late, some efforts at minimizing the release of such pollutants in the environment are emerging in Bangladesh due to intervention by the courts. Similar interest in improving the industry's performance is also developing in Pakistan.

Recognizing the need for coordinated action on the issue, the International Convention for the Safe and Environmentally Sound Recycling of Ships was adopted by a diplomatic conference under the auspices of the International Maritime Organization in Hong Kong, China, in May 2009. The Hong Kong Convention (HKC) is expected to enter into force in 2015.

ECONOMICS OF THE SHIP BREAKING AND RECYCLING INDUSTRY

> The overall finding is that a more environmentally sustainable ship breaking and recycling industry will remain competitive in Bangladesh. Subject to incentive adjustments, it can also remain so in Pakistan.

The relocation of the industry to South Asia in the 1980s and the region's success in retaining it since then has contributed to significant economic development in that region. This growth in ship breaking activity is due to both supply side attributes and demand conditions in the three countries and the region as a whole. A large labor supply, low labor costs, and a relative lack of environmental and occupational health regulation have all been vital. Also important is the fact that Bangladesh and Pakistan features some of the largest current and pent-up future global demand for the SBRI's outputs—notably, relatively low-grade mild steel bars and rods for use in construction.

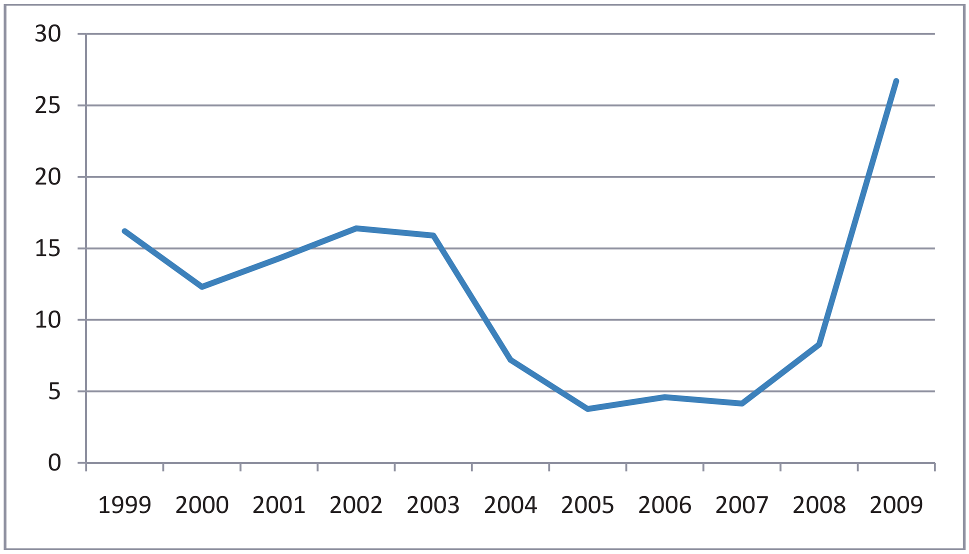
Table ES 1. SBRI contributions in Bangladesh and Pakistan, 2008/2009

	Bangladesh	Pakistan
National steel production	2.2–2.5 m tons	3 m tons
Scrap steel from ship breaking	Up to 1.5 m tons	Up to 800,000 tons
Ship breaking steel's contribution to production	50%	15%
No. of re-rolling mills	250 to 350	330
Scrap yards (total no.)	40 active	30 active (132)
Estimated no. of workers in yards	22,000	6,000–8,000

Large-scale SBRI exodus from Bangladesh and Pakistan is considered unlikely at this time, as opposed to what happened in Japan and Taiwan in the past. The demand for construction materials in Bangladesh and Pakistan is underpinned by a continuously expanding urbanization process in countries with very large populations. Possible relocation may be driven by low costs, including both wages and costs resulting from regulation. The available information indicates that Cambodia and Myanmar have lower wage rates than Pakistan, whereas Bangladesh might still be able to compete with them on wages. Hence, the risk of relocation from a wage point of view seems more threatening for Pakistan. However, the beaching method for dismantling old vessels also depends on a domestic steel market, a market for other recyclable items, and natural conditions of high tidal gauge and wide beaches. Given the relatively low likelihood of meeting all these conditions in other locations, it is not considered likely that the SBRI will relocate on a large scale from Bangladesh and Pakistan in the immediate future.

The supply of vessels for scrapping from the shipping sector is subject to large variations as a consequence of the global demand for seaborne transport. Between 2004 and 2008 shipping saw unsurpassed freight rates as a result of high demand for maritime transportation. That high demand kept even older ships in operation during that period. This resulted in a record low number of vessels being offered for scrapping. On average, some 700–800 ships larger than 499 gross tonnage are scrapped annually, but during the shipping industry's global boom years the figure was only 300–400 vessels. Following the recent economic recession, however, the demand for maritime transportation has declined. As a result, the number of vessels scrapped in 2009 is estimated to have reached 1,200 equal to a capacity of more that 25 million gross tonnage.

Figure ES 1. Scrapped tonnage 1999–2009 (million gross tonnage)



Source: Mikelis 2007 and Fairplay 2010

The future demand for scrapping is not expected to fall to previous lows even if the global economy picks up. This is due to the generation of a massive order book in the shipbuilding yards during the boom years, which will be completed in 2008-2012. Thus tonnage will be in excess of demand for at least 5-10 years to come. Already today, more ships are laid-up than for the past 20 years and unless global market conditions change dramatically, a significant part of this fleet will undoubtedly go directly for scrapping.

The study assessed the profitability (and hence competitiveness) of the industry in Bangladesh and Pakistan under the prevailing environmental and occupational health regulatory conditions. The estimates used in the analysis are based on reviews, updates, and assessments of previous economic, econometric, and financial studies, as well as on field interviews with a large number of stakeholders. The estimates are subject to some degree of uncertainty, given the nature of the industry and the historic lack of reliable data. For cross-country comparison purposes, all calculations are based on a "sample" ship—a Panamax oil tanker of 14,800 LDT (80,000 DWT).[2] All major elements of revenue (from steel and other recyclable items) and costs (from the purchase of the ship, labor, and financial costs) were considered to determine profitability.

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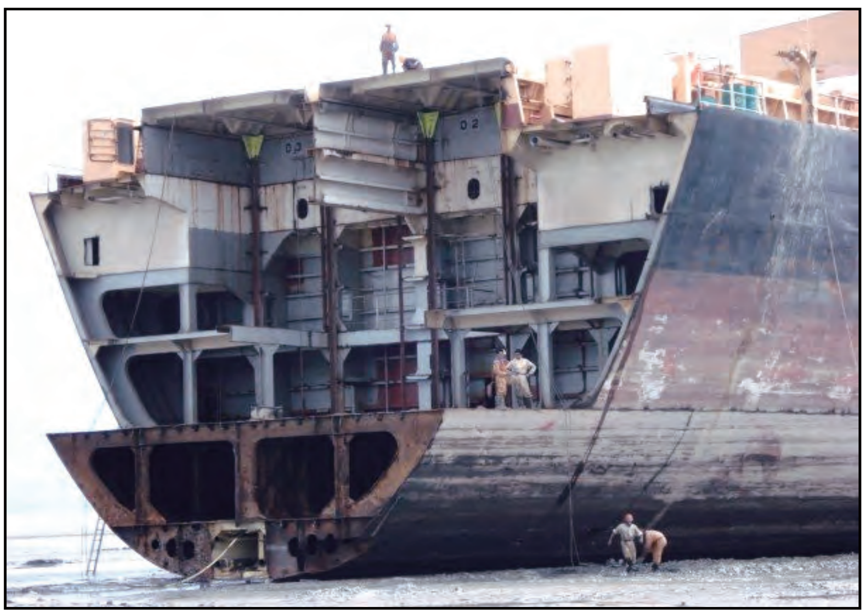
[2] LDT (light displacement tons or lightweight) denotes ship displacement, in tons, without cargo, fuel, lubricating oil, ballast water, fresh water and feed water, consumable stores, and passengers and crew and their effects, but including liquids in piping. DWT (dead weight tonnage) denotes the lifting or carrying capacity of a ship when fully loaded. The deadweight is the difference, in tons, between the fully loaded ship and its lightweight.

Table ES 2. Main cost and profit margins of ship breaking and recycling in Bangladesh and Pakistan, mid-2009 (recalculated to percent for comparison)

	Bangladesh	Pakistan
Costs		
Purchase of ship	69%	70%
Labor costs	2%	4%
Consumables	5%	4%
Financial costs	3%	5%
Taxes, tariffs and duties	5%	13%
Other costs (incl. investment costs rents, and other costs)	1%	1%
Total costs	**84%**	**97%**
Comparable profit	16%	3%

The overall finding is that ship breaking under the prevailing environmental and occupational health regulatory conditions is a competitive industry in Bangladesh and, to a lesser extent, Pakistan. The levels of profitability indicate that there is scope for developing more-sustainable practices in Bangladesh without damaging the overall competitiveness of the industry—and without increasing the risk of relocation of the industry. As profitability is lower in Pakistan, there is likely to be less scope for imposing new and tougher environmental regulation without corresponding adjustments in the industry's taxation and incentives structures, as the introduction of higher costs could lead to a relocation of the industry to other countries.

Figure ES 2. A ship being broken in Chittagong, Bangladesh



Photograph courtesy of Susan Wingfield, 2007

HAZARDOUS MATERIALS FROM THE SHIP BREAKING INDUSTRY

A considerable amount of hazardous materials has already accumulated in Bangladesh and Pakistan as a result of SBRI activities. Some hazardous materials are exposed during dismantling and are managed (or spilled and spread) locally, but a considerable amount is carried with equipment off the yards. This material may re-enter society in disguise. For example, wall panels with asbestos have typically been used in furniture for sale in roadside shops outside Chittagong. The material can also travel into the hinterland with the motors, cables, transformers, air conditioning systems, and other items reused in the region. In addition, the ODS emitted during ship breaking typically carry considerable global warming potential.

During the study, yards in Bangladesh and Pakistan were tested for soil contamination. A widespread but varying degree of contamination of ship recycling yards at Chittagong (Bangladesh) and Gadani (Pakistan) was found, with deposits of cadmium, chromium, lead, and mercury. Oil aside, the results are consistent with previous limited studies on marine sediments in the vicinity of ship breaking yards. This contamination is indicative of the threats to the environment caused by the practices and improper management of hazardous materials during the dismantling of ships. In a number of samples the lead and oil concentrations raise concerns regarding the working environment.

Soil contamination found in sites in Bangladesh and Pakistan:
- Cadmium from 0.6 to 2.2 mg/kg
- Chromium from 2.42 to 22.12 mg/kg
- Lead from 11.3 to 197.7 mg/kg
- Mercury from 0.078 to 0.158 mg/kg
- Oil from 485 to 4,430 mg/kg

As a result of analysis for this study, it was determined that:
- Asbestos will remain a significant long-term problem (as it is still found in newly build vessels).
- PCBs will still occur in older vessels and naval vessels.
- PCB-contaminated cables are a key area of concern.
- No collection or management options for ODS are available.
- Metals in paint pollute the work environment.
- Large volumes of oil and oily water must be managed.

Dioxins may be generated while burning cables to obtain copper, but fortunately it is technically simple to manage and enforce a stop to this practice. In the re-rolling mills, however, the heating of painted steel plates (in particular, those painted with chlorinated rubber paints) is also conducive to dioxin generation, and little information is available on this source.

Hazardous materials that remain on beaches can be well managed locally with improved housekeeping practices and with adequate handling and storage. The lack of hazardous waste disposal and treatment facilities in Bangladesh and Pakistan means that wastes produced must nevertheless be disposed of somewhere. And informal disposal may occur on the beaches, on adjacent unused plots, or on other land in the vicinity.

Large amount of hazardous materials are likely to accumulate in both Bangladesh and Pakistan if the prevailing practices continue over the next 20 years Based on the ship breaking work likely to be carried out in the yards in Bangladesh and Pakistan between 2010 and 2030, an estimate was prepared about accumulation of hazardous material in the three countries assuming continuation of the prevailing practices. Table ES 3 shows that the impact is likely to be the more in Bangladesh than in Pakistan. A major reason for the lower estimate for Pakistan arises from the fewer ships likely to be recycled there.

Table ES 3. Accumulated hazardous material amounts from ship breaking and recycling in Bangladesh and Pakistan, 2010-30

Hazardous material	Unit	Bangladesh	Pakistan
Asbestos	t	79,000	5,200
PCBs (mainly cables)	t	240,000	16,000
ODS (mainly polyurethane foam)	t	210,000	14,000
Paints (metals, tributyltin (TBT), and PCBs)	t	69,200	4,550
Heavy metals	t	678	45
Waste liquid organic	m^3	1,978,000	130,000
Miscellaneous (mainly sewage)	m^3	107,000	7,000
Waste liquids inorganic (acids)	t	775	51
Reusable liquids organics	t	675,000	44,200

Bangladesh and Pakistan both possess some form of a basic control mechanism for ship recycling, which is usually based around the "no objection" concept. However, such mechanisms do not meet the international norms being put in place under the Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships. Both Bangladesh and Pakistan will need extensive institutional building and infrastructure upgrading to meet those standards.

THE CONSEQUENCES OF SEA LEVEL RISE

Environmental damages could worsen as result of sea level rise. The SBRI location and industrial practices make it highly vulnerable to the impacts of climate change and especially to sea level rise. The industry's legacy pollution could pose significant threats and challenges at both local (particularly in Chittagong) and regional scales as rising ocean and tide levels submerge beach and near-shore ship breaking areas, washing out accumulated pollutants. In storm surge events, a sudden release of quantities of the contaminated landside beach material into the marine zone may severely affect local fisheries. Preliminary estimates of the amount of sand that could be disturbed and washed out from the beaches in Chittagong and Gadani in the long term have been made. The estimates are based on very conservative, mid-range sea level rise estimates (0.21–0.48 meters based on the A1B scenario of the Intergovernmental Panel on Climate Change).

Table ES 4. Contaminated sand exposed to sea level rise in Chittagong and Gadani

Beach	Slope; Length	Polluted sand under new high tide (0.21–0.48 m sea level rise)
Chittagong, Bangladesh	0.05; 13 km	11,000–25,000 cubic meters
Gadani, Pakistan	0.08; 7 km	3,500–8,100 cubic meters

The estimates clearly indicate the risk of having vast amounts of sand contaminated from present and historic ship breaking activities exposed to dynamic tidal and wave action over the long term. Such redistribution of metals and persistent pollutants from their relative immobilization in the dry sand and shore soils to the dynamic aquatic ecosystem of the tidal zone will pose direct environmental and human health hazards, including through the transfer of pollutants in the marine and human food chains. Combined with other runoff from industrial discharges, this added pollution pressure can affect biodiversity and economically important areas such as fisheries and fish and shrimp farms.

Table ES 5. Impacts of climate change on ship breaking yards and coastal areas

Event	Impact	Effect	Mitigation
Sea level rise	Tidal erosion of beaches	Loss of beaching facility	Coastal protection works
Storm surges	Damage to infrastructure	Yard buildings undermined and lost	
	Loss of coastal roads	Roadside shops destroyed	Relocation
		Roadside community dwellings submerged	Relocation
Higher tides	Release of heavy metals, TBTs, and PCBs from yards into the coastal environments	Fisheries and shrimp hatcheries poisoned	Pre-emptive de-pollution or stabilization of contaminated areas

RECOMMENDATIONS

Based on economic, market, and environmental assessments, an overarching strategy has been developed with the following objectives:

- To reduce the risks to and impacts on workers and the environment of unsafe dismantling practices in the recycling yards

- To provide safe storage, transport, and disposal options for hazardous materials derived from the recycling process in order to reduce the distribution of unsafe materials in communities
- To provide options for financing investments and managing them through public-private partnerships
- To clean ships prior to starting any breaking or recycling activity.

Enforcement on the ground needs to be improved. The proposed strategy includes institutional capacity building, enforcement of regulations, and investment in waste management facility. Institutional technical capacity is strongly needed in both Bangladesh and Pakistan. However, the need to strengthen monitoring and enforcement capacity in both countries is essential. With regard to infrastructure development, significant investment in hazardous waste management is required to achieve compliance with the Hong Kong Convention as well as other relevant international agreements and guidelines in both Bangladesh and Pakistan. The implementation of interventions in the area of hazardous waste management and disposal may present opportunities for engaging in public-private partnerships in Pakistan and Bangladesh.

A key recommendation of the study is to reduce the risks from hazardous materials before ship recycling commences. It was found that ships for recycling often call at Karachi and Chittagong or anchor outside for approvals. Such calls can be made mandatory, as it provides an opportunity to perform various pre-demolition cleaning activities such as cleaning cargo tanks, emptying bilge tanks, paint and chemical stores, and waste oil, and unloading surplus fuel under controlled conditions. To manage the operationally generated waste of ships calling at the ports of Karachi and Chittagong, in particular ships on their final voyage to the Chittagong beaches, MARPOL reception facilities should be developed[3]. These facilities may, in light of the particular situation at a port of final call, be supplemented with a capacity for handling solid waste and non-operationally generated waste, providing a broader cost recovery base.

Recommendations for Bangladesh

Considerable efforts are needed in Bangladesh to achieve adequate institutional capacity and provide ground-level enforcement of protection of workers and environment in the ship breaking industry. Infrastructure improvement regarding the capacity and safety of the main road for transport of all waste and reusable materials generated in the ship breaking yards should be initiated. Significant infrastructure and capacity development in the hazardous waste management sector is required to achieve proper storage and disposal levels in the long term in order to comply with the HKC and other relevant international agreements.

Given the proximity of the Chittagong municipal area, interventions in hazardous waste management and disposal may present opportunities for engaging in public-private partnerships in Bangladesh to the benefit of the greater urban zone, the port of Chittagong, and the ship breaking industry. Opportunities for establishing an import tax regime directed at funding the investments may also be pursued.

Table ES 6. Necessary measures to achieve HKC compliance in Bangladesh

Time frame	Measures	Inv. costs ($ million)
1–2 years	Worker registration Onsite pollution and safety control equipment Environmental health and safety procedures and ship recycling action plan	3.5
3–5 years	On site equipment (variable) Training/capacity Health care system Monitoring laboratory	20–25
6–10 years	Hazardous waste disposal thermal treatment facility	25
Optional	Pre-cleaning and waste reception facilities in Chittagong	10–14
>2 years	Road upgrade (20 km Dhaka-Chittagong)	20

[3] MARPOL is the international treaty regulating disposal of wastes generated by the normal operation of vessels.

Recommendations for Pakistan

More investments are needed in Pakistan to achieve an adequate institutional capacity, to provide ground-level protection for SBRI workers, and to enforce environmental regulations. Although the SBRI industry is situated in a relatively unpopulated area, infrastructure improvements are needed in the capacity and safety of the main road for transport of all waste and reusable materials generated in the ship recycling yards. Significant infrastructure and capacity development in the hazardous waste management sector is required in particular in the long term in order to achieve proper storage and disposal levels leading to compliance with national regulations, the Hong Kong Convention, and other relevant international agreements. Investments in hazardous waste management and waste disposal may present opportunities for engaging in public-private partnerships to the benefit of the local urban area of Hub, the greater urban zone of Karachi, the Port of Karachi, and the ship breaking and recycling industry.

Figure ES3. A ship ready for breaking in Gadani, Pakistan

Photograph courtesy of Susan Wingfield 2009

Table ES 7. Necessary measures to achieve HKC compliance in Pakistan

Time frame	Measures	Investment costs (million dollars)
1–2 years	Worker registration and personal protective equipment Onsite pollution and safety control equipment Environmental health and safety procedures and ship recycling action plan	2–3
3–5 years	On site equipment Training/capacity Health care system	10–15
6–10 years	Hazardous waste disposal thermal treatment facility	25
Optional	Waste reception facilities in Karachi	10
>2 years	Road upgrade	20

1 Introduction

1.1 Background

Sea going vessels or ships have a normal lifespan of about 30/40 years after which any repair or renovation becomes uneconomical. These ships are then retired and sold for scrap to commercial ship breakers. Until well into the 20th century, ship breaking used to be carried out in industrialized ports including those in USA and UK. Thereafter, the major centers of the ship breaking and recycling industry (SBRI) first moved from Europe and North America to East Asia and, since the 1980s, to South Asia. Since ship breaking involves highly labor intensive work, the SBRI has gravitated to countries with availability of low wage labor. In addition, weak occupational health and environment regulations, and little or no enforcement may also have been a contributory factor for the emergence of a large SBRI sector in South Asia.

At present, the global center of the ship breaking and recycling industry is in South Asia, specifically Bangladesh, India, and Pakistan. These three countries account for 70–80 percent of the international recycling market for ocean-going vessels, with China and Turkey covering most of the remaining market. Only about 5 percent of global volume is scrapped outside these five countries. This study focuses on the SBRI in Bangladesh and Pakistan to get a better understanding of the economics of the industry and the environmental impacts arising out of such activity and to explore possible ways in which such environmental effects may be mitigated.

In some ways ship breaking can be considered a "green industry". Almost everything on the ship and the ship itself is recycled and reused, thus adding to the sustainability of our natural resources and the environment. However, the process of recycling itself can also lead to environmental problems. This is because ships contain many hazards that, if not handled and disposed off in a safe manner, can have significant detrimental effects on both human health and the environment. In designing, constructing, and operating ships, a wide range of materials are selected for their technical characteristics, often to provide fire protection or meet other maritime safety requirements. When exposed in the process of ship demolition and recycling, such materials may pose a hazard to the demolition workers' health or the environment.

The volume of hazardous materials handled in the SBRI is expected to increase significantly with the implementation of International Maritime Organization (IMO) regulations for the phase-out of single-hull tankers from 2010 to 2015. In addition, the overcapacity built in the maritime transport sector during the 2002–08 "boom" years is now fueling a wave of ship retirements, providing for an increased flow of hazardous material to the South Asian SBRI yards over the next 10–15 years

Over the years, the SBRI in Bangladesh and Pakistan has accumulated a long record of work-related injuries and fatalities and has only recently begun to adopt practices for safe management and disposal of hazardous materials. The problem is symptomatic of the overall lack of proper disposal facilities for such materials in Bangladesh and Pakistan; to date. The limited basic infrastructure in ship breaking yards is often highlighted by the industry as a major constraint to the development of a "green" SBRI, as is the lack of appropriate disposal facilities for hazardous materials in Bangladesh and Pakistan.[4]

In December 2005, in recognition of the need for international action to address SBRI pollution and safety issues, the IMO Assembly agreed that a new legally binding instrument on ship recycling should

[4] "We are working in an atmosphere of poor infrastructure, high taxes and mounting tariff pressure. We do not have child labor, the industry is mechanized, people wear proper uniform, goggles and gloves to be safe from hazards. We even do not have drinking water, electricity, telephone lines and waste landfill," declared Pakistan Ship Breakers' Association member Asif Ali Khan on the unfair treatment of the industry in Pakistan regardless of the better conditions for workers here than in other ship breaking countries (Khan, 2009)

be developed under IMO auspices. The International Convention for the Safe and Environmentally Sound Recycling of Ships was adopted by a diplomatic conference in Hong Kong, China, in May 2009. The Hong Kong Convention (HKC) is expected to enter into force in 2015.

The HKC will require that signatories ensure that ships flying their flags are only recycled in another state that is party to the convention and under conditions that comply with its work safety and hazardous waste handling requirements. The SBRI in Bangladesh and Pakistan may require significant investments in procedures, equipment, and facilities to achieve compliance. If Bangladesh and Pakistan are to join the Convention, they may further need to fill additional regulatory, institutional capacity, and infrastructure gaps. The costs of upgrading an entire sector should be seen relative to the revenues and profits it generates. However, only limited information is currently available to develop an accurate estimate of any future investments.

This study seeks to strengthen the knowledge base with respect to competitiveness and profitability of the SBRI and to investigate the feasibility of ship breaking countries in this region, specifically Bangladesh and Pakistan, achieving compliance with the HKC without jeopardizing the future of the industry there.

1.2 Objectives and scope of study

The objective of the study is to inform key stakeholders associated with policy making and ship breaking including the government of Pakistan and the government of Bangladesh about the current problems encountered in the SBRI and suggest a road map to help strengthen institutional and regulatory systems that can improve work practices in the ship breaking and recycling industry. The study addresses the following:

- It assessed the productivity, competitiveness and growth potential of the industry in Bangladesh and Pakistan (Chapter 2);
- It undertook environmental audits of hazardous waste materials present in ships scheduled for dismantling and established a pollution inventory as well as projections of hazardous materials till 2030 (Chapter 3).
- It provides a plan of action to enable Bangladesh and Pakistan comply with the newly signed Hong Kong Convention without jeopardizing the future of the SBRI in these countries (Chapter 4).

1.3 Study methodology

In this study, **ship breaking and recycling is defined as an industry that, through the use of land, infrastructure, machinery, and labor and through the consumption of utilities, converts ships that have outlived their economic life into steel and other recyclable items**, which are then sold in local markets. The study was cover a period of 11 months in 2009. It consisted of an economic and market assessment of the SBRI in Bangladesh and Pakistan; environmental audits of ships and ship recycling facilities to establish a pollution inventory and a gap analysis and needs assessment for compliance with the HKC. The process included active consultations with key stakeholders in industry, government, and nongovernmental organizations in the two countries involved as well as other countries and agencies concerned with the SBRI at the global level. Appendix 1 outlines the detailed methodologies followed for each of these activities.

2 The Economics of the Ship Breaking and Recycling Industry

This chapter presents an assessment of the economics of SBRI in Bangladesh and Pakistan by examining the industry's growth, profitability, and productivity. Specifically, the discussion focuses on:

- The SBRI's historical development and current trajectory within its global industrial context
- The structure and performance of the industry relative to market demand for its outputs
- The policy and business environment in which it operates
- Localized social and economic impacts and their management.

Historically, there has been limited analysis of the overall economics of the SBRI and of its competitiveness. Most studies have mainly focused on the process of ship breaking and its environmental and social consequences. As a result, information on the economics of the industry is typically either glossed over or examined in a very general and superficial way. Profitability is only assumed in consequence of supply side factors, and economic significance is usually viewed as a result of the apparently high employment in the industry and its multiplier effect. Until now, there has been little analysis of the downstream demand for SBRI outputs and how it contributes to the industry profitability.[5]

At present the SBRI in Bangladesh and Pakistan is mainly concentrated at two ports/ship breaking areas:

- Chittagong in Bangladesh
- Gadani in Pakistan

Such geographic concentration of ship breaking and recycling activity is no accident. The formation of these clusters have been driven by locational advantages as well as the presence of upstream suppliers and downstream re-rolling mills and the easy access to reworking or processing, wholesaling, and retailing of other recyclable items. Over time, the SBRI concentration in the two locations in these countries have become a part of wider metropolitan complexes—spanning the wider urbanized areas of Chittagong and Karachi.[6] This has further helped in attaining the economies of scale needed for the SBRI to grow and prosper.

The SBRI's ongoing growth, development, and performance in each place benefit from external economies of scale or agglomeration economies in two forms:

- Localization economies: productivity-enhancing economies of scale that are internal to the industry and arise from "within-industry" interactions that accrue to firms on account of the size of the industry in a specific location
- Urbanization economies: productivity-enhancing economies of scale arising from the size and diversity of the urban setting that are external to a particular sector or industry but available to all firms.

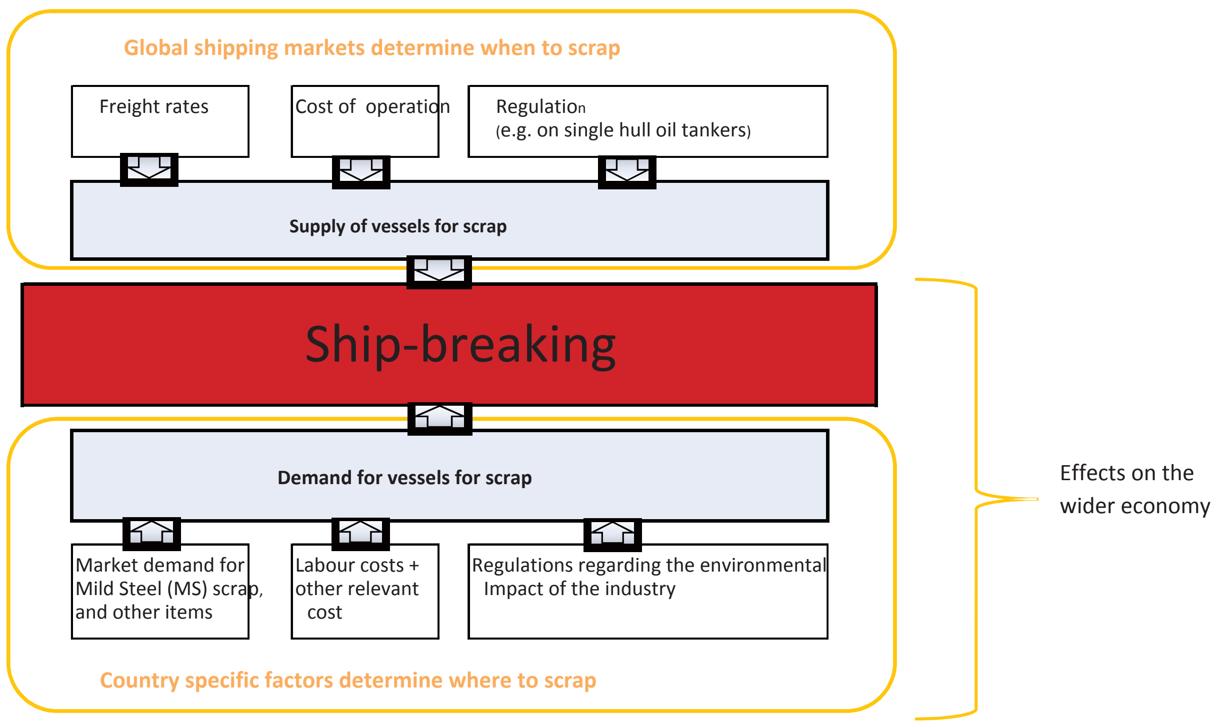
[5] See IMO 2009b, where the difficulties of researching the SBRI are discussed, including that it is unrecognized as a formal industry in South Asia, it is highly visible and hence politically contested, existing research reports tend to represent partisan interests, and statistical sources and estimates are often unreliable.

[6] See Misra and Mukherjee 2009, pp. 23–32. There is limited ship breaking and broader SBRI activity in other locations in Pakistan (Karachi), and Bangladesh (Dhaka and the port of Mongla in Khulna Division). At national and regional levels, the industry is dominated by activity in Gadani, and Chittagong. It should be noted that the dock or quay-based industry in China is also geographically concentrated: there are some 90 breaking yards on the Yangtze and Pearl Rivers, with the principal activity occurring on the Yangtze in Zhang Jijang (Changjiang) in Jiansu Province, and other yards in Fujiang and Guangdong provinces. By the end of 2007, only 20 remained in operation in China. However, it appears that this large amount of spare or underutilized ship-breaking capacity is now being reactivated and reaching its limits.

2.1 Global SBRI supply and demand dynamics

At any particular time, **broad global, regional, and national economic contexts determine both the supply of ships for scrap to the SBRI and the demand for the industry's output of recyclable materials**, principally scrap steel.[7] (See Figure 2.1.) On the supply side, freight rates, along with the costs of keeping a vessel in operation, emerge as the most important determinants of a ship owner's decision about when to send that vessel to a ship breaker. On the demand side, the market demand for scrap metal is a direct function of the price of steel and the costs associated with the scrapping industry itself, including costs associated with the breaking process relative to predicted revenue.

Figure 2.1 Ship breaking: Supply and Demand



Like any other industry, the SBRI is also driven by profit considerations. The decision of a ship breaker to enter the market is influenced by the national and local possibilities to sell scrap steel and other recyclable items, which will determine potential revenues. The cost structure (varying from country to country) is mainly determined by local wages, tariffs, and duties and by the level of implementation of national and international regulations regarding workplace safety and environmental impacts. Usually, labor is the most important variable on the cost side.

The largest portion of the ship breaker's revenues arises from the sales by ship breakers of ferrous or mild steel (MS) scrap, which is high-quality ship steel scrap. The Market of MS consists of two segments (fig 2.2):

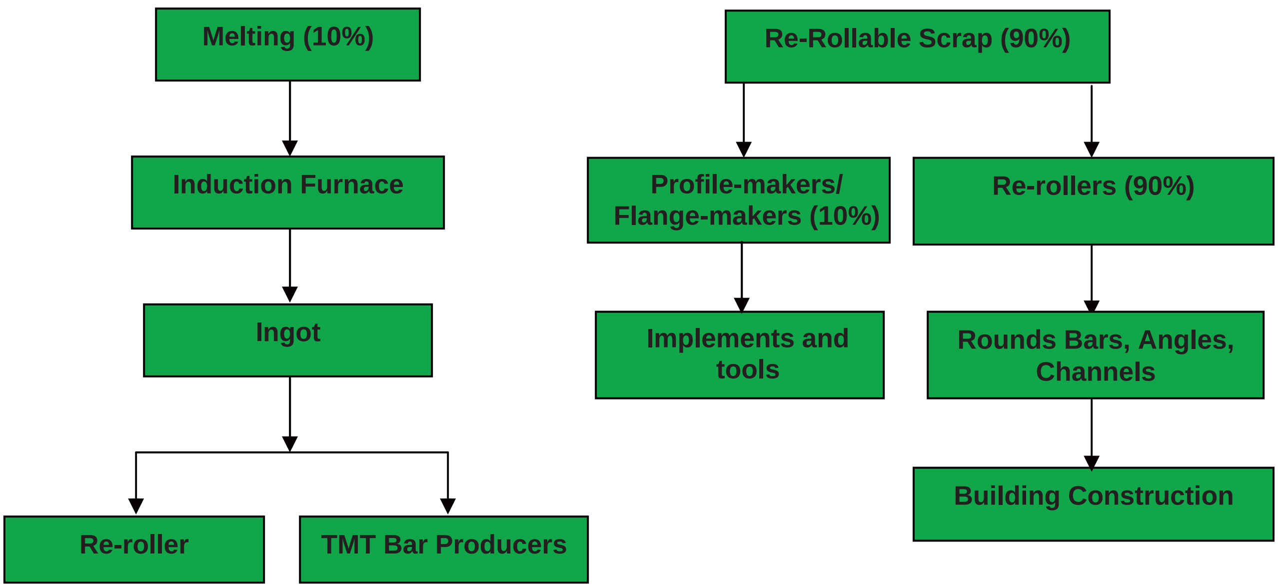
- *Re-rollable scrap*: Higher-value steel plates, which can be heated and re-rolled, primarily in bars and rods for construction (typically a minimum 70 percent of the recycled ship's light displacement tonnage (LDT) [8]). Other re-rollable scrap end-users include profile-makers, profile-makers, and flange, makers.

[7] See European Commission 2004, Chapter 4, for a detailed description of the dynamics of the market.
[8] LDT (light displacement tons or lightweight) denotes ship displacement, in tons, without cargo, fuel, lubricating oil, ballast water, fresh water and feed water, consumable stores, and passengers and crew and their effects but including liquids in piping.

- *Melting scrap*: Smaller pieces of scrap iron, which are melted in induction furnaces to make ingots whose main buyers are re-rolling mills (10–20 percent of LDT).

The majority of ship recyclers do not sell ferrous scrap directly to end-users. Some of the recyclers in Bangladesh are an exception to this trend, as they also own re-rolling mills and construction companies within larger, vertically integrated industrial conglomerates.

Figure 2.2: End-of-life ships: Ferrous Scrap Market Structure



A variety of other recyclable materials and products are also recovered from the ships, including cabin (furniture, appliances, building materials), appliances and implements; machinery; pipes; electric motors/panels/generators; cables; hydraulic equipment; radio room equipment; etc..As in the case of the ferrous scrap, the ship recyclers do not sell these recoveries directly to end-users but to local and national retailers. The local market largely focuses on cabin recoveries to serve household needs, while the regional and national retailers also cater to hotels and industry demand.

Ship breaking is an extraordinarily volatile industry as it experiences alternating periods of boom and bust corresponding to the supply and demand dynamics. The SBRI performs especially well in periods of economic contraction and recession and is affected in the opposite direction in periods of economic growth. This volatility and the lack of a demonstrable, consistent upward growth trend for the industry, either globally or at the national or regional level, make it difficult to assess the competitiveness and sustainability of the industry in any given national or regional context merely in terms of growth.

In the aftermath of stagnation in the 1980s and weak growth in the 1990s, shipping markets experienced an unprecedented boom starting in 2001 that peaked in 2007. As the global economy went into severe recession in the last quarter of 2008, world trade volumes and shipping activity collapsed simultaneously, and freight rates plummeted dramatically, for some vessels by as much as 99 percent. By mid-2009, rates had recovered to roughly a quarter of the peak level.

The global SBRI found many more ships available for scrapping and recycling as owners returned ships on time charter, "mothballed" them, or sought to dispose through demolition what had swiftly become unproductive assets. This was in strong contrast to the previous shipping boom years, when high freight rates had restricted the supply of vessels for scrap and made them very expensive. In addition, as the crisis hit in 2008, owners failed to cancel new ship orders quickly enough. The situation at that time, and future indications of uncompetitive excess capacity, drove rates down further, while at the same time increasing the short- and medium-term supply of older vessels for scrapping.

Globally, the supply of vessels for scrap has thus increased significantly since late 2008. As a result of this excess supply, the price that owners could get for vessels suitable for scrapping initially declined sharply in Fall 2008. However, as shipping volumes started to rise again and rates began to improve, there was a partial recovery of such price in 2009. The first nine months of 2009 saw an upsurge in ship breaking, with the recycling levels of 2000 already in sight. (See Table 2.1.)

Table 2.1. Ship breaking activity in LDT and percent of global scrap volume and location, 2002 to September 2009

Countries	2002	2003	2004	2005	2006	2007	2008	09/2009
China								
LDT	1,466,780	1,985,070	716,360	86,510	112,950	9,130	245,360	2,223,870
%	21%	33%	22%	6%	6%	1%	8%	27%
India								
LDT	2,892,210	2,606,170	971,710	373,830	321,490	556,120	1,091,500	3,155,230
%	41%	44%	30%	28%	16%	35%	35%	38%
Bangladesh								
LDT	1,659,450	782,010	1,294,210	795,030	1,181,160	650,750	1,372,050	1,863,530
%	24%	13%	40%	59%	58%	41%	44%	23%
Turkey								
LDT	69,370	56,560	24,130	12,860	230,000	3,110	0	178,500
%	1%	1%	1%	1%	11%	0%	0%	2%
Pakistan								
LDT	358,410	196,520	77,040	7,350	56,790	152,660	135,550	574,480
%	5%	3%	2%	1%	3%	10%	4%	7%
Other								
LDT	523,620	260,590	126,490	72,990	149,740	204,710	249,690	242,470
%	8%	4%	4%	5%	7%	13%	8%	3%
South Asia								
LDT	4,910,070	3,584,700	2,342,960	876,210	1,559,440	1,359,520	2,599,100	5,593,220
%	70%	61%	73%	65%	76%	86%	84%	68%
Total LDT	6,969,740	5,886,920	3,210,130	1,348,570	2,052,130	1,576,470	3,094,150	8,238,050

Source: N. Cotzias Shipping Group S&P Monthly Reports

2.2 Growth of South Asia's SBRI within the global industry

The SBRI has been a mobile industry that is subject to wholesale withdrawal from countries and to radical shifts in location. Within the past 25 years or so, the SBRI has undergone a profound relocation from East Asia to South Asia. While China has remained a major actor at times and is rebounding strongly, the South Asian SBRI has dominated the industry since the late 1980s and early 1990s. (See Table 2.2.)

By the year 2000, the SBRI in South Asia captured close to three-quarters of the global ship breaking market in terms of dismantled tonnage. During the last ten years, the regional leadership in ship breaking has alternated between India and Bangladesh. Pakistan, a regional leader during the 1980s, has remained a minor actor for the last two decades and has only recently seen its recycling volumes pick up again. By becoming the market leader in SBRI, the industry in India and Bangladesh has attracted the most public and media attention, particularly on the environmental and labor impacts of the ship breaking activity.[9]

[9] See, for example, the overviews of public concerns in Buncombe 2009 and Hoetzgen 2009.

Table 2. 2. Ship breaking activity and location, 1977–2008

Country	1977	1980	1985	1990	1995	2000	2005	2008
Taiwan	3,391	4,409	7,822	2	-	14	-	-
Spain	873	279	603	13	40	26	5	6
S. Korea	221	168	2,551	4	3	1	-	-
Italy	229	101	198	7	1	2	-	-
Croatia	151	62	130	1	-	-	1	-
Japan	193	129	973	81	146	22	-	-
China	17	7	5,019	81	754	2,637	151	928
India	66	136	1,303	1,092	2,810	5,987	1,123	2,458
Bangladesh	-	-	818	217	2,539	2,407	2,114	4,176
Pakistan	299	300	1,143	2	1,670	789	48	274
South Asia	-	436	3,264	1,311	7,019	9,183	3,285	6,908
Others	653	431	1,669	315	560	1,271	330	437
World	6,093	6,022	22,229	1,645	9,435	13,552	4,021	8,280

Source: Shipbuilders' Association of Japan, 2009.

The large-scale location shift or "transboundary relocation" of the SBRI from one country or region to another is usually ascribed to lowering of labor costs. However, since ship breaking can lead to major environmental problems, differences in environmental regulation is also frequently cited as a cause that triggers such move. Thus SBRI is often seen as a "pollution haven" industry that gets concentrated in regions with the least environmental regulation. Undoubtedly, these factors explain some of the reason for the rise of the SBRI in South Asia. However, the demand side of the equation in motivating relocation across national borders is also important. This demand arises from the downstream industries that use the recycled products as inputs. Yet the demand for recycled products obtained from ship breaking is often underplayed or even ignored as a factor in explaining the industry's location and performance.

2.3 The iron and steel industry and scrap steel demand from the SBRI in Bangladesh and Pakistan

The SBRIs in Bangladesh and Pakistan face their own demand conditions for steel within the structure of the broader international and national iron and steel industries, and more specifically within the so-called secondary steel subsectors. The SBRI is also involved in the rolling segment within secondary steel.

The global iron and steel industry has seen enormous expansion, with output increasing by 50 percent from 2002 through mid-2008, with an all-time high of 1.34 billion tons in 2007 and combined sales of more than $1,000 billion. After a fall of 20 percent in the first half of 2009, steel output rallied, and the overall decline in output for 2009 was expected to be on the order of 10 percent.[10]

The demand and prices for scrap steel also boomed after 2002, with prices quadrupling from 2002 to late 2007. This was followed by a very steep fall in late 2008, in parallel to the sharp fall in industrial production. The recovery since then has been slow and patchy.[11] As a large contributor of scrap steel, the SBRI industry is also impacted by such market gyrations in demand and prices for scrap steel.

There are three stages in steel production: iron making, steel making, and rolling. The three stages also broadly define three types of firms depending upon what is used as input:

- Integrated steelworks, which start at the very first stage of iron making and combine all three stages

[10] See Cooney 2007 and Madar 2009 for global steel industry dynamics.

[11] See Seabrook 2008 for an excellent account of the global scrap steel industry.

- Steelworks that only combine steel making and rolling processes, often known as a mini-mill
- Rolling firms, which buy semi-finished steel products and use hot-rolling or cold-rolling processes to produce a variety of long-steel and flat-steel products

There is no single best path to meeting steel demand in a given national setting and any or all of the three types of steel production can be found. Generally, the scale and composition of domestic demand sets a principal basis for the technological choices made by industry actors. However, medium and small-scale production systems, which feature mini-mills or rolling firms, tend to be studied much less than national systems oriented around integrated steelworks.

The market situation in each country can vary substantially, determining the SBRI prospects in that specific environment. The relocation of the SBRI to South Asia in the 1990s and the scrapping region's hold on the industry since then can be traced to supply-side attributes as well as to demand conditions in the region as a whole and in individual countries. A large labor supply, low labor costs, and a relative lack of environmental regulation have also been vital in this transition.

Both Bangladesh and Pakistan feature large current and pent-up future demand for SBRI outputs, notably relatively low-grade MS bars and rods for use in construction. This has spawned a thriving, if low-productivity, re-rolling mill segment downstream of ship breaking. Thus SBRI has made a significant contribution to the overall steel production and consumption in the two countries in this region.

Bangladesh

Bangladesh's domestic steel production is insufficient to meet national demand, which is estimated at 5 million tons a year. The country has somewhere between 250 and 300 rolling mills currently in operation (out of an estimated total of 350). Their production—essentially Bangladesh's domestic steel output—is estimated at around 2.2 million tons a year, with sales valued at $1.2 billion. Some 30 percent of this output is contributed by a few big firms. Current construction consumption of bars and rods is between 2 million and 2.5 million tons a year.

The SBRI output in Bangladesh, either plate or melting scrap, mainly feeds the smaller operators who produce perhaps 70 percent of re-rolling mill output in the form of lower-quality 40-grade rod. These smaller mills are principally located in Chittagong and Dhaka. Using recent annual average of 1–1.25 million tons of scrap output from Chittagong's ship breaking yards, it estimated that Bangladesh's SBRI contributes significantly to the country's steel production – perhaps up to 50 percent, This downstream demand for steel scrap has been a major driving force in the growth of the SBRI in Bangladesh.

Pakistan

Pakistan's steel industry has undergone a difficult period in the past decade. Total consumption in 2005 was estimated at 4 million tons. In the so-called unorganized sector, there are some 80 scrap melting plants (mainly induction furnaces) and 334 re-rolling mills. Most of the latter are located either in the Punjab (250 in Lahore, 16 in Islamabad, and 16 in Gujranwala) or in Sindh (52 in Karachi). Gadani ship scrap's contribution to Pakistan's steel consumption and production is also significant, though difficult to assess. With an average output of 500,000 tons per year, it could account for up to 15 percent of Pakistan's steel production.

Summary of supply and demand

The continuous high demand for SBRI outputs in Bangadesh and Pakistan (see Table 2.3) makes it unlikely that in Bangladesh and Pakistan will witness a wholesale exit from the industry as happened in

Taiwan and Japan earlier. The demand for construction materials in in Bangladesh and Pakistan is underpinned by an urbanization process involving a very large population that has a long way to run[12].

Table 2.3. SBRI contribution to steel production and consumption in Bangladesh and Pakistan, based on 2005–08 data

	Bangladesh	Pakistan
Steel Consumption	5 m tons	4–5 m tons
Steel Production	2.2 to 2.5 m tons	3 m tons (target 2015: 10 m tons)
Scrap Steel from Ship Breaking	Up to 1.5 m tons	Up to 0.8 tons (2009)
Ship-breaking-steel Contribution to Production	50%	15%
Ship-breaking-steel Contribution to Consumption	20–25%	10%
Re-rolling mills	250–350	330

m = million

2.4 Industry structure, market demand, and performance

Bangladesh

After a slow beginning, ship breaking on the 18 km Sitakunda coastal strip in the area of Fauzdarhat north of Chittagong took off in the 1980s, driven by demand for ship scrap steel. By the mid-1990s, the Bangladeshi industry had risen to the number two spot behind only India in tonnage scrapped. Although subject to fluctuation, Bangladesh's share has not fallen below 40 percent of the total worldwide ship demolition volume in the last five years. At present, Chittagong's ship breakers are participating fully in the upsurge of ship recycling, with some 1.9 million LDT scrapped from January to September 2009. It is estimated that total LDT intake in 2009 either equaled or exceeded historical highs in the past decade.

At the present time some 40 ship breaking and recycling yards are in operation in Bangladesh, up from 26 in 2008. In the past decade, the number of ship recyclers has typically fluctuated between 30 and 40. Some 8–10 of these are larger, diversified companies, which are integrated upstream into oxygen plants and downstream into re-rolling mills. Ship breaking yards are in close proximity to both larger and smaller re-rolling mills that produce steel rods, bars, angles, and channels, principally for use in the construction industry. In addition, other goods from ships—from furniture to electrical generators—are recycled and used intensively in Bangladesh, perhaps to a greater degree than in the other South Asian countries.

The Bangladesh Ship Breakers Association is the official association of ship recyclers. Almost all the ship breakers in Chittagong are its members. Cutting contractors are represented by their own association, and there is also a Bangladesh Steel Mills Owners Association and Bangladesh Re-Rolling Mills Association. The ship recycling output is almost entirely used locally in Bangladesh. However, the degree to which ship scrap steel in both plate and MS forms is processed locally in the Chittagong area is difficult to ascertain, as there are a large number of unregulated, smaller re-rolling mills in the area.

Items are sold directly from the yards and transported at the buyer's expense. Ship breakers who have their own re-rolling mills use the scrap ship steel principally for rebar production in their mills. Ship breakers that are not downstream-integrated generally sell scrap steel to scrap buyers. The end users, re-rolling mill

[12] Current populations: 153 million in Bangladesh and 172 million in Pakistan. Urban population as percentage of total population: 25 percent in Bangladesh (30 percent by 2015) and 35 percent in Pakistan (40 by 2015) (World Bank 2009).

operators, do not buy directly from the ship breakers, as the relationship between the two parties is somewhat strained. The purchase of steel plates by ship builders for repairs or for building small vessels was reported as significant by government shipping department officials but was considered to be of lesser importance by the ship breakers themselves.

Figure 2.3 Ship Breaking in Chittagong, Bangladesh

Photograph courtesy of Frank Stuer-Lauridsen

Pakistan

Ship breaking in Gadani has been ongoing since pre-partition days. Realizing its importance, the government of Pakistan took practical measures to strengthen the industry in 1978, including classifying Gadani as a port, reducing import duties, and establishing a task force for infrastructure and logistical issues. In its early years, Gadani could be said to have brought to prominence the competitive value of the beaching method, and it produced approximately 1 million tons of scrap during the 1980s. It is estimated that at its peak the ship breaking industry of Gadani employed close to 30,000 people. However, the combination of stronger competition from India and Bangladesh and changing tax and regulatory regimes saw its decline, and ship scrap output dropped to less than one-fifth of the level in the1980s.

In the early 1990s, a 45 percent customs duty was imposed on ships imported for dismantling. This adversely affected ship breaking activities at Gadani, almost halting the industry by the early 2000s. In recent years, ship breakers and local authorities have successfully lobbied for reducing duties and taxes. The industry has thus recovered considerably recently, although volumes are far below those of Bangladesh. Nonetheless, ship breaking is the largest industry in Balochistan province providing local employment to 20–25 percent of the total Gadani workforce and a major source of tax revenue for the provincial and federal government and for the Balochistan Development Authority (BDA). It is reported that the federal government proposed additional taxes on ship breaking activities recently but that these were dropped after the intervention of the Chief Minister of Balochistan.

There are 132 ship breaking plots at Gadani. Some two-thirds are under private ownership; the rest are owned by the BDA. At present, about 30 active ship breakers operate on land leased either from these local landlords or from the BDA. Each ship breaker uses an average of three plots, with the five largest breakers using four or more. In a similar fashion to the Bangladeshi industry, most ship breaking operations form part of small, diversified industrial groups. There is a measure of forward integration into both steel and construction. About 75 percent of the ship breakers hail from the Gujarati-speaking community, 20 percent are from the Punjab, and the remaining 5 percent are of Pathan descent.

The main entry barrier is the availability of ship breaking yards and plots. It was primarily for this reason that ship breakers continued paying lease payments to landlords or the BDA to avoid losing their yards during the industry downturn. There is no real exit barrier, and plot owners can leave at will. The Pakistan Ship Breakers Association formed in 1979 is the main organization in the SBRI in Pakistan.

Given the present political conditions in Pakistan, it is difficult to get a clear picture of current market conditions for ship scrap steel. Ship plate and melting scrap from Gadani are used as an input to the 50–60 re-rolling mills in Sindh and Balochistan, but the degree to which these products are used in the Punjab, which dominates the re-rolling segment, is unclear. The research primarily indicated that some 70–75 percent of Gadani's production is destined for Karachi's re-rolling mills and 25 percent for the Punjab. The industry is thus significantly localized, with small re-rolling mills in particular dependent on ship breaking for their inputs. Some 95 percent of overall revenue is said to come from the sale of scrap steel, with the remainder coming from other recyclable items sold in the Sher Shah Market in Karachi.

2.5 Profitability and competitiveness

Essential to an assessment of the SBRI's competitiveness is analysis of its profitability under the prevailing environmental and occupational health regulatory regimes. The estimates used in the analysis here are based on reviews, updates, and assessments of previous economic, econometric, and financial studies, as well as field interviews with a large number of stakeholders. The estimates generated are, however, subject to some degree of uncertainty. For the sake of cross-country comparison, all calculations are based on a "sample" ship: a Panamax oil tanker of 14,800 LDT (80,000 DWT) with the major elements of revenues and costs being as follows:[13]

Revenues:

- Steel—the most crucial recyclable output in terms of volume and revenue. This steel is either reheated and re-rolled or melted down and re-processed.
- Other recyclable items—including non-ferrous scrap, machinery, furniture and fixtures, and ropes and cabling. Virtually, all items that can be recovered from a ship are recycled in some form.

Costs:

- Purchase of ship[14]
- Investment costs (for equipment and civil works such as cranes, forklifts, storage, and housing)
- Financial costs
- Labor costs
- Consumption of utilities (e.g., oxygen, LPG, diesel and electricity)
- Taxes, tariffs and duties (e.g., import taxes)
- Rents (e.g., for land use)
- Other costs (e.g., for handling hazardous waste).

[13] DWT (dead weight tonnage) denotes the lifting or carrying capacity of a ship when fully loaded. The deadweight is the difference, in tons, between the fully loaded ship and its lightweight.

[14] The costs of buying a vessel for scrap are roughly the same across scrapping destinations as they compete for the same ships and as ship owners sell to the buyers who are willing to pay the highest price. However, it is common to see differences of $25/LDT across countries, in particular for Bangladesh, where tankers fetch a premium due to the relative ease of dismantling and high re-rollable fraction. Given the large fluctuations in prices over time, this is of less importance if ship owners are indifferent about where their ships are scrapped, which most often will be the case. But when, for example, stories in the media have perpetuated negative perceptions of the industry in a particular country, this might not be the case (see, for example, GMS 2009).

The results of the assessment are summarized in Table 2.4 (see Appendix 4 for further details).

Table 2.4. Overview of revenues, main costs, and profit for a sample ship in Bangladesh and Pakistan, mid-2009 (in dollars)

	Bangladesh	Pakistan*
Revenues	5,613,600	5,505,500
Total costs	4,692,200	5,340,900
- Purchase of ship	3,848,000	3,848,000
- Labor costs	92,700	233,400
- Consumables	302,200	230,000*
- Financial costs	147,900	265,700
- Taxes, tariffs, and duties	263,000	693,600
- Other costs (including rents, investment costs, etc.)	38,400	70,200
Profit	921,400	164,600

*As information on use of consumables in Pakistan was unavailable, it was estimated based on data available from India.

Bangladesh

According to ship breakers in Chittagong, approximately 85 percent of a ship is recyclable steel in the form of directly re-rollable steel (75 percent) and melting scrap (10 percent).[15] It is estimated that ship breakers' revenue from steel amounts to $4,771,500. Combined with the industry estimate of revenue generated by other recyclable items, total revenue is estimated at $5,613,600.

The existing estimates of the price of ships vary considerably. To allow for comparison across the region, the analysis assumed that the price of a ship was the same in both countries—that is, $3,848,000, excluding taxes. Investment costs for equipment and civil works have been estimated to be in the region of $441,200. After assumptions pertaining to depreciation and residual value are made, this figure is reduced to $21,900 per ship and included in "Other costs".

Detailed information on financial costs is lacking for Chittagong and indicators of interest costs vary. An estimate based on the average of these indicators suggests a total financial cost of approximately $147,900, somewhat lower than for Pakistan. A number of taxes are imposed on ship breakers in Chittagong totaling approximately $263,000, although this too is subject to uncertainty. A number of rents and charges are also applied, including rents for leased land, port charges, beaching costs, and tug charges. In addition, ship breakers pay a fee to the Bangladesh Ship Breakers Association and a donation to a local cutting commission. The analysis found that there appear to be no costs related to a levy for housing or a development fund for workers, labor safety, training, or insurance.

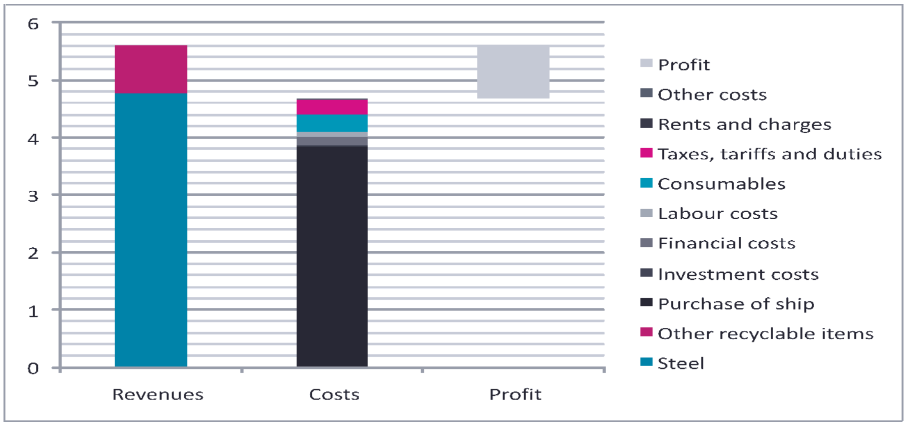
Because of a lack of more detailed information on the staffing for ship breaking in Bangladesh, the labor costs were estimated based on data available from SBRI in India. With the assumption that Bangladeshi ship breakers need approximately the same number of workers as in India to manage the breaking up of the sample ship, the labor costs amount to $92,700 (combining salaried workers with workers on a daily wage).[16] The costs of consumables that aid the dismantling process (such as oxygen, LPG, and diesel) have increased in recent years and are estimated at approximately $302,200.Overall, based on revenue and costs it is estimated that ship breakers in Bangladesh earn a profit of $921,400 per ship. The results

[15] There are different estimates on the proportions of steel output. One ship-breaking yard managing director suggests a somewhat higher proportion of melting scrap than assumed here, but given the preference for tankers, the high re-rolling proportion is kept.

[16] Data available from India suggest 396 hired workers on a yearly basis, with an activity of around two ships per year. So, it is assumed that this corresponds to around half of this per ship. This corresponds to other sources that estimate approximately 200 workers per ship in ship breaking industries.

imply profitability (profit/revenue) of around 15 percent (see Figure 2.3), which corresponds to industry assessments.

Figure 2.4 Revenue, costs, and profits for a sample ship in Bangladesh, mid 2009



- Steel prices are high due to low level of competition
- Revenue from "other recyclable items" is more than in Pakistan
- Labor costs are very low in Bangladesh
- Costs of consumables (primarily oxygen and LPG) are higher than in Pakistan
- Taxes are lower than in Pakistan
- High profitability

Pakistan

In similar fashion to the ship breaking industry in Bangladesh, **the revenues for ship breakers in Gadani, Pakistan, stem from two sources: steel and other recyclable items**. The sales price of steel plates varies according to quality. The sample ship provides 12,580 tons of steel, generating total revenue of approximately $4,992,800. The common practice in Pakistan is to sell all other recyclable items to a bulk buyer at a small premium over the normal steel price, amounting to an estimated $512,700 in revenue, with machinery and generators accounting for the greatest share. In total, it is estimated that the ship generates revenue of approximately $5,505,500.

Pakistani industry sources indicate that **the cost of acquisition does not vary significantly from the estimate of $3,848,000 identified for Bangladesh**. The analysis found that initial investment costs for civil works and equipment depend on a number of factors, although considerable investments are also made in infrastructure. If the same assumptions as used for the cases of Bangladesh are applied, the investment/depreciation costs amount to approximately $18,300, which is also included in "Other costs".

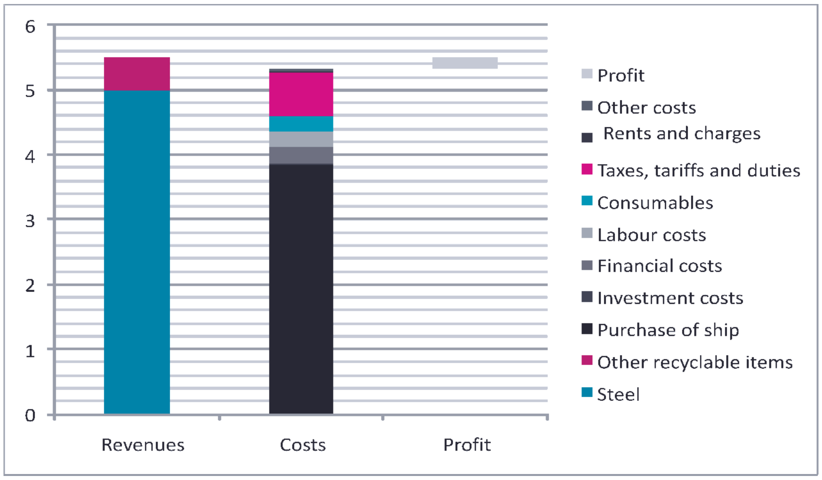
In terms of financial costs, **Pakistan has very high interest rates ranging from 17 to 18 percent per annum**. This amounts to $265,700 per ship for Gadani ship breakers for a 180-day period. The ship breaking industry in Pakistan is subject to four types of taxes, including a Balochistan Development Authority charge. These amount to approximately $693,600. Shipyards are either owned by local Balochi leaders or are leased from the Balochistan Development Authority, and thus a rental is charged per plot.[17]

Wage levels are considerably higher in Gadani than in the yards of Bangladesh—indeed, the daily wage is up to two to three times higher than in Bangladesh. Combined labor costs for the dismantling of the sample ship amount to $233,400. Estimates indicate that Pakistani workers should be substantially more efficient than in Bangladesh, where more workers are employed over a longer dismantling period, reflecting, in part, a higher level of mechanization in Gadani. Due to limitations of data availability, the consumable costs in Pakistan are estimated based on data available from India. After dismantling, steel is transported at the expense of the ship breaker, and so additional "Other costs" are incurred for transport of approximately $49,500 per ship. Various operating costs are also incurred throughout the breaking process, such as tug charges and environmental impact assessment/ initial environmental examination costs.

[17] Based on information supplied by Mr. Shahid, Manager, Usman Enterprises, Gadani, who is paying rental of Rs 170,000 per plot.

Overall, the analysis found that ship breaking in Pakistan is profitable but at a relatively low level. (See Figure 2.4.) It is estimated the average profit for the sample Panamax oil tanker is $164,600, or 3 percent of total revenue.

Figure 2.5 Revenue, costs, and profits for a sample ship in Pakistan, mid-2009



- Steel prices are relatively high
- ”Other recyclable items” account for less than in Bangladesh
- Total labor costs > Bangladesh
- High productivity is more than outweighed by high wage rates
- The level of taxation is more than twice the level of Bangladesh
- Lower profitability than in Bangladesh
- High steel prices, but also a high level of taxation

The estimate of profitability for ship breakers in Pakistan is, however, subject to a degree of uncertainty as the current political situation made it difficult to obtain a complete picture of costs and revenues for the industry. This difficulty affected the cost items which explain the lower level of profitability in Pakistan as compared to Bangladesh, i.e. higher taxes, higher financial costs and higher labor costs.

Consistent information on the effective level of taxation, in particular, proved difficult to come by. Reports on the issue were somewhat dated and contradictory -- and there were even indications of the actual tax level being slightly lower than what is presented above. The recent intervention of the local Balochistan authorities against additional taxes proposed by the Federal Government is one possible explanation for these inconsistencies and for the uncertainty about the level of taxation. Information on financial costs for Pakistani ship breakers is also scarce, with the costs appearing to vary across Gadani’s ship breaking yards.

Regarding labor costs, **it was difficult to assess to what extent higher wages in Pakistan are offset by higher productivity** due to the higher onshore level of mechanization in Gadani compared to Bangladeshi yards. Furthermore, the estimated labor cost figure for Pakistan is sensitive to the level of activity at the ship breaking yards, as a larger share of the workforce is on long term rather than temporary contracts. The data presented above reflects costs and revenues for a period with a medium level of activity. Consequently, labor costs per ship tend to be lower and profitability higher during periods with a higher level of activity, as has increasingly been the case through 2009 and into 2010.

Comparison across countries

The country comparison shows that **the industry is more profitable in Bangladesh, primarily due to two factors: high steel prices and low labor costs**. The level of revenue is relatively high in Pakistan due to high steel prices, but this is more than offset by a high level of taxation. The overall finding is that ship breaking under the prevailing environmental and occupational health regulatory regimes is a competitive industry in Bangladesh and, to a lesser extent, in Pakistan.

These levels of profitability indicate that **there is scope for developing more sustainable practices in Bangladesh without damaging the overall competitiveness of the industry**—and thereby without increasing the risk of relocation of the industry. As profitability is lower in Pakistan, however, there is likely to be less scope for imposing new and tougher environmental regulations, as the introduction of higher costs could lead the industry to relocate to other countries.

Sensitivity Analysis for Ship Purchase Price

In the main analysis above, a base case of $260/LDT was used as the purchase price for end-of-life ships. Over the last 15 years, however, the price for end-of-life ships has fluctuated between $120 /LDT and $700 /LDT. Ship breakers may make or lose money at any level of ship purchase price as the scrapping and recycling business operates on the margin between the ship purchase price and the local scrap steel price. When in 1999, for example, the price for end-of-life ships was low, local scrap steel prices were also correspondingly low. Because ship breakers operate on this margin they are not so sensitive to the actual day-to-day level of prices but rather to sudden large price fluctuations, as there is a time lag between when the price for the ship is fixed and when income is generated from selling the scrap steel to local buyers. The price ship breakers are willing to pay for ships thus depends on their expectations for future scrap steel price developments.

The 2008 crisis illustrates the sensitivity to steel price changes after the purchase of ships for scrapping. At the peak period in mid-2008, some ship scrappers paid as much as $700/LDT for end-of-life ships. At that time, local prices in Bangladesh and Pakistan for re-rollable steel and melting scrap were about twice as high as indicated above in the base case. The ship breakers expected further increases. Sensitivity calculations show that even with increased local steel prices, ship breakers would experience a severe loss when paying $700/LDT for end-of-life ships. Additional sensitivity tests show that Pakistani ship breakers needed a further increase of 10-25% in local steel prices to break even, whereas the ship breakers in Bangladesh could, at best, have just broken even. In reality, as the global economic crisis hit in late 2008, the prices for all types of steel plunged, including those for ship scrap. This caused some of the most severe losses in the history of the industry.

2.6 Policy and business environment

Government policy

The government does not officially recognize ship breaking as an industry in Bangladesh; instead, ship breakers run their business with a trade license obtained from a government agency. As a result of this unofficial status, Bangladeshi ship breakers do not receive any government grants, subsidies, or tax waivers. Yet ship breaking is governed by certain environmental rulings, some of which appear contradictory in practice. The Department of Shipping within the Ministry of Shipping has assumed some responsibility for the industry, and recent reports suggest that a draft Ship-breaking and Recycling Policy has been developed.[18]

In Pakistan, imported iron and steel materials are taxed heavily by the government so as to promote indigenous production of raw materials. As indicated earlier, during the course of this study it was revealed that the central government had planned to levy additional taxes on ship breaking activities for the current fiscal year. Due to the intervention of the Chief Minister of Balochistan, however, such a move has apparently been postponed indefinitely.

Land, Infrastructure, and Planning

In Bangladesh, the land on which the ship breaking yards are built is partially leased and partially owned. Given the unofficial status of the industry, limited infrastructure is provided by the government, and yard owners themselves pay for repairs to access roads that suffer under heavy yard traffic. Although

[18] Shaams 2010.

electricity is supplied to the yards, it is unreliable, and yard owners must rely on generators recovered from the ships. With no connection to the city water supply, they have also installed tube wells for workers.

In Pakistan, the Gadani beaching area has more than 100 plots, mostly owned by a local Balochi tribe leader, with just 31 owned by the Balochistan Development Authority. The annual cost per plot charged by the former is almost five times that charged by the latter. Since 1978, the BDA has met the basic infrastructure needs of ship breakers, although this has been limited to poor-quality access roads. The supply of electricity is intermittent and unreliable, and very few yards are connected to the grid, despite being in the Karachi Electric Supply Corporation catchment area. Despite a large-scale water supply scheme, there is still a severe shortage of water, and yard owners must purchase supplies privately.

2.7 Social and economic impacts

Bangladesh

Approximately 22,000 workers are directly employed by the ship breaking industry in Bangladesh, and as many as 200,000 are employed indirectly through ancillary activities. These numbers vary according to market conditions and might have increased recently as a result of the uptake of recycling activities since early 2009. The majority of workers are young, male, and largely illiterate; very few women work in the yards. It is estimated that up to 95 percent of the workforce is migrant laborers from Bangladesh's poorest districts.

Third-party accounts estimate that over the last 30 years as many as 1,200 workers died in the Chittagong yards as a result of dangerous working conditions.[19] Local media reports list 21 fatalities in 2009 alone. Hazard and safety awareness and the use of personal protective equipment (PPE) among workers is traditionally low. Research for this study could not confirm whether the use of PPE and the provision of safety awareness training have increased in recent times. Informal compensation arrangements exist for workers' families in the event of injury or fatality, at the discretion of yard management. Facilities for workers are lacking, including sufficient potable water sources and provision of latrines. Health care in the yards is usually limited to first aid. Medium and long-term health problems, ranging from muscle pain to skin disease, are a growing concern. In 2002–03, for example, Dr Biswajit Roy of the Department of Occupational and Environmental Health, NPSOM, found that 88 percent of workers interviewed suffered some form of accidental injury—from foot injuries to serious accidents—while working in the Chittagong yards.

Recruitment for the yards at Chittagong occurs in a number of ways and it is common for men in a particular family to follow older male relatives to the yards. The Chittagong workforce includes both salaried and daily wage employees. The average monthly salary is approximately TK 12,500, while daily wages are approximately TK 225. In both cases, wages are based on the skill required. Workers do eight-hour shifts, with regular overtime of four hours that is paid at the same rate. Work is carried out in two shifts, day and night, for approximately 24 days a month. No official training is given to new employees as they join the yards. Rather, new workers tend to "shadow" the more experienced workers, sometimes for months or years at a time. Career progression is based on years of service.

Some 25 percent of the workers live in rent- and bill-free sheds close to the yards, provided by the yard owner, accommodating approximately 70 workers split between three or four rooms. These cramped living arrangements facilitate the spread of infection and illness. The remaining workers rent basic accommodation in groups nearby. No workers' union exists at present, and although many workers believe that a union would bring improvements to their situation, most are averse to organizing one for fear of putting their jobs at risk.

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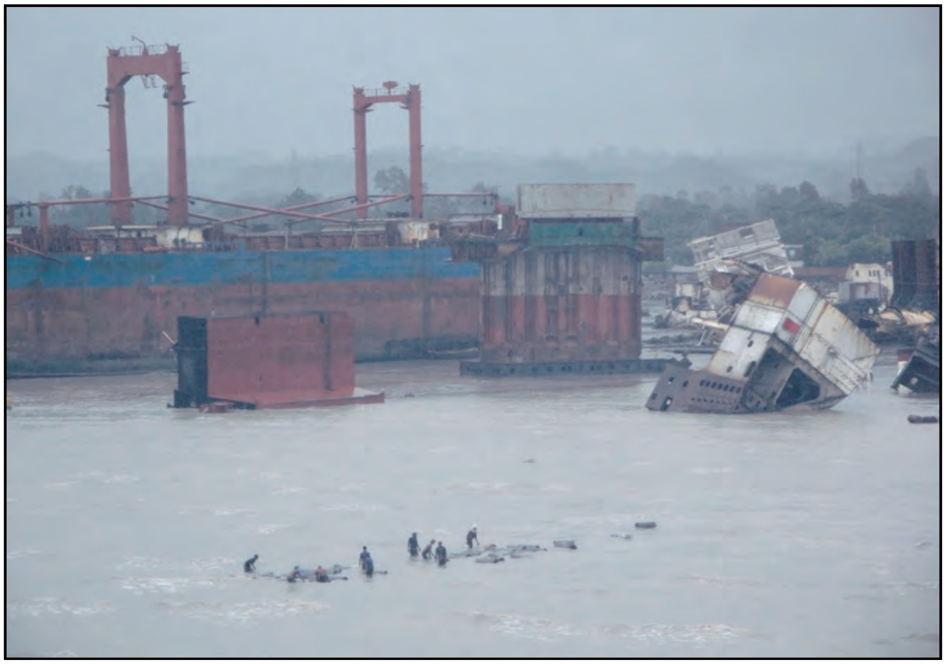
[19] Greenpeace and FIDH 2005.

Figure 2.6 Ship Yard in Chittagong, Bangladesh



Photograph courtesy of Frank Stuer-Lauridsen

Pakistan

During its heyday, approximately 30,000 workers were directly employed by the Gadani ship breaking yards in Pakistan. In recent years this has decreased significantly to between 6,000 and 8,000, with approximately 4,000 more indirectly employed through ancillary activities. Both figures are likely to increase in the coming years. Industry representatives indicate that virtually no women or children are employed in the ship breaking yards. Up to 75 percent of the total workforce are migrant laborers, although this statistic varies significantly between yards.

While working conditions at Gadani have been denounced by labor organizations, **there is a higher degree of mechanization than in Bangladesh**, which mitigates some risks. However, the industry is still in strong need of modernization. There is conflicting evidence regarding the state of working conditions and safety and hazard management at Gadani. Injuries and fatalities in 2009 have been attributed to dangerous conditions, although research for this study indicates that recent improvements have been made and that PPE is now mandatory in many yards. But health care facilities are ill equipped to deal with the nature and extent of injuries common to ship breaking. Only basic first aid is provided to workers on site, and no trained medical staff are present. The seriously injured must be transported to Karachi, and the resulting delays for treatment can prove fatal.

The Gadani workforce consists of salaried and daily wage employees. The average daily wage for an eight-hour shift is between Rs 350 and Rs 700, depending on experience. An additional four hours of overtime is commonplace and paid at the same rate, with workers opting to leave yards that cannot offer overtime. Gadani is the only area in this study where labor shortages have been a problem (according to Diwan Rizwan, chairman of the Ship Breakers Association). Salaried workers provide the required skilled labor in the yards and earn between Rs 25,000 and Rs 30,000 per month. After the closure of a Ship Breakers College, which provided technical training to new recruits, workers now train on the job by assisting and shadowing the more experienced and skilled employees. Career progression is based on years of service, and only the most experienced and longest-serving workers do demolition work aboard the ship itself.

Little information is available on the living conditions of ship breaking workers in Pakistan. The vast majority of workers appear to be provided with accommodation by the yard owners, containing the bare minimum of facilities recovered from the ships themselves. The accommodation available to workers at Gadani appears to be of a slightly higher standard than what is available in Bangladesh. However, there is no supply of potable water and an absence of sanitation facilities. A scheme to provide 1,000 housing units to workers was recently announced.

The Gadani workers have organized themselves into a Ship-breaking Labor Union, which in February 2009 successfully campaigned for a 40 percent wage increase, better working conditions, and improvements to medical facilities. Other reports describe a “pocket” union, composed of “loyal” workers, that has been put in place by the ship breakers to rival the official union, thus denying true worker representation.

3 Environmental Status of Bangladesh's and Pakistan's Ship Breaking and Recycling Industry

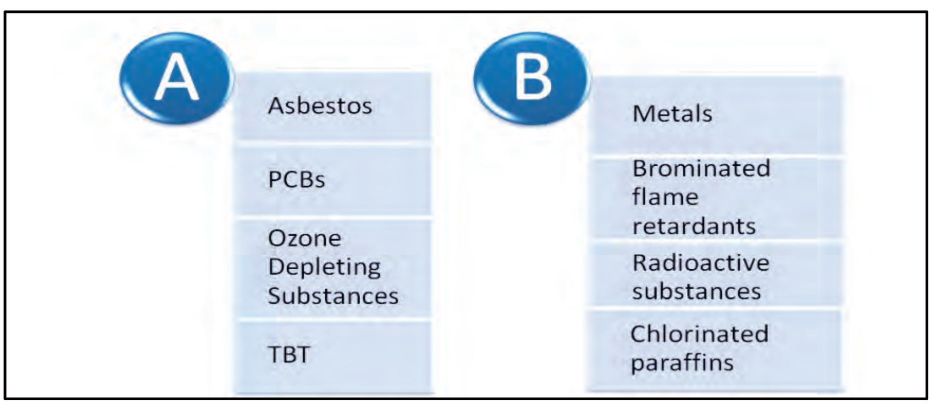
This chapter establishes a pollution inventory and baseline data for the ship breaking and recycling industry in Bangladesh and Pakistan based on environmental audits of the hazardous waste materials present in a structured sample of ships scheduled for dismantling and for recycling facilities. In addition, an analysis of the institutional infrastructure in these countries is provided and compared with the emerging standards and requirements expressed in the Hong Kong Convention. Finally, a gaps and needs analysis is presented that provides estimates of the likely costs for upgrading facilities and meeting implementation needs, including regulatory infrastructure.

3.1 A review of the import of hazardous materials

This section presents information gathered during 2009 on hazardous materials in ships, their management in the ship breaking sector, and imports of hazardous materials to the SBRI over the next 20 years. The booming international freight rates of the cargo transport market in 2004–08 kept every ship trading and consequently the level of ship scrapping very low. The market conditions in the second half of 2008 and throughout 2009, in contrast, filled nearly every slot of the beaches at Chittagong and Gadani

The new International Convention for the Safe and Environmentally Sound Recycling of Ships is expected to enter into force in 2015. A key requirement under the HKC is the Inventory of Hazardous Materials (IHM) that is to be completed by the ship-owner and provided to the recycler before commencement of recycling (see Figure 3.1). Lists A and B below present the hazardous materials that a ship's inventory shall include as a minimum. The materials in list A are further to be banned by the HKC contracting parties in all new ship construction. The materials in list B can be part of the ship's design but have to be declared in the inventory.

Figure 3.1 Mandatory hazardous materials to be inventoried before recycling a vessel



With an IHM document in hand, the importing nation can ascertain whether the authorized hazardous waste management facilities available can adequately store or treat the materials found on the vessel. Today, the IHM of ships is still a rare item to find in the public domain. Most such information is confined to government-owned vessels, such as warships, coastguard ships, and ships arrested in ports and scrapped at the taxpayer's cost. This study collected such data and also generated new data through interviews with ship breakers and inspections on ships (see Appendix 5). The data has been used to establish the current "import" of hazardous materials in ships and project an estimate for 2010–30. The limited datasets are not necessarily indicative of a complete lack of information on hazardous materials. According to several classification societies, today hundreds of vessels do carry a certified inventory in accordance with the previous guidelines[20] (the Green Passport) or a statement of compliance with the new IHM under the HKC. But these data are proprietary and were not available to the study.

Hazardous materials currently on ships

The inventories reviewed during the study fall into two categories: naval and non-naval (merchant) vessels (see Table 3.1). Naval warships are built to different specifications than merchant vessels, particularly with regard to the management of risk of fire and explosions, and thus have a higher occurrence of hazardous materials. In contrast, the extent of hazardous materials in Merchant vessels can vary as they come in many types, including liquefied gas carriers, dry bulk, reefers, oil tankers, roll on–roll off (Ro-Ro), and containers. Such design type may affect which hazardous materials are typically found onboard. But due to the limited availability of dataset it was not possible to consider this in the study. The results for merchant vessels are therefore presented on the basis of a measure of cargo capacity—that is, gross tonnage (GT) as recommended by the IMO—and represent 14 inventories, 3 of which were undertaken as part of this study. The results for naval vessels are based on displacement, which here equaled light displacement tons, a common measure of the steel weight of a vessel. No inspections were made of naval vessels during the study, and the IHM datasets include 13 vessels. An overview of these data is available in Appendix 5.[21]

The data for naval vessels, reveals that the amounts of asbestos and possibly polychlorinated biphenyls (PCBs) in such ships exceed those expected in typical merchant ships.[22] In particular, the previous investigation of the *USS Oriskany* a 27,100-displacement-ton aircraft carrier commissioned in 1950, showed that in naval vessels of this age PCB was abundant. While the occurrence of PCBs in general appeared to be random, with a number of samples showing high PCB content (>10,000 ppm) and more than half the samples at >50 mg/kgall cables were above the threshold level for hazardous waste categorization, and the average concentration of PCBs was 1,500 ppm. Very little merchant-vessel-specific information is available, and an allowance has been made for this potential contribution in the summary table.

[20] IMO Guidelines on Ship Recycling (A23/Resolution 962).
[21] Calculations are based on declared hazardous materials from one container ship, four ro-ros, five oil tankers, three chemical tankers, and one service vessel.
[22] For naval ships: two aircraft carriers, four supply/cargo, two miscellaneous, one radar vessel, and four tankers.

Table 3.1. Amount of hazardous material per million GT on merchant and navy vessels

Hazardous Material	Unit	Merchant Vessels** Material/ million GT	Merchant Vessels** Panamax tanker 40,000 GT	Navy Vessel** Material/ million LDT	Navy Vessel** Destroyer class 5,000 LDT
Asbestos	ton	510	20	17,000	86
PCBs					
PCB liquids (transformers, etc.)	kg	0	0	No info. available	
PCB solids (capacitors, ballasts, etc.)*	kg	1.7	0.07	5,500	28
Hydraulic oil	ton	110	5.0	1,600	8.0
Ozone-depleting substances **(ODS)**					
ODS liquids (CFC, Halons, etc.)	ton	7.0	0.3	No info. available	
ODS solids (e.g., polyurethane (PU))	ton	1,800	70	No info. available	
Paints					
Paints no info	ton	420	17	39,000	200
Paints containing tributyltin (TBT)	ton	14	0.56	No info. available	
Paints containing PCBs	ton	No info. available		No info. available	
Paints containing metals	ton	No info. available		25,500	130
Heavy metals					
Cadmium (merchant); lead (naval)	ton	1.9	0.08	34	0.17
Mercury	kg	44	1.8	75	0.38
Radioactive substances	kg	No info. available		No info. available	
Waste liquids organic	m^3	5,650	230	1,900	9.0
Reusable liquids organic (HFO, diesel)	ton	3,200	130	23,000	110
Miscellaneous					
Ballast water (C-34)	ton	60,000	2,400	280,000	1,400
Sewage (C-35)	m^3	660	26	No info. available	
Garbage (C-42)	ton	2.3	0.09	No info. available	
Incinerator ash (C-41)	ton	1.9	0.08	No info. available	
Oily rags (C-45)	ton	3.1	0.12	No info. available	
Batteries nickel/ cadmium	units	170	7.0	No info. available	
Waste liquids inorganic (acids)	m^3	0.28	0.01	430	2.0
Reusable liquids organic (other)	m^3	620	25	1,500	7.0
Equipment					
Batteries lead (C46)	ton	2.2	0.09	34,000	170

*Merchant vessel does not estimate PCBs in cables due to lack of data.
**For both categories an example is given for a typical-size vessel. The underlying IHM datasets include 14 merchant and 13 navy vessels.
**All figures are rounded to two significant figures.

Hazardous materials tonnage projected to 2030

The hazardous materials tonnage is then projected to 2030 based on a 4 percent annual increase in global tonnage, which is the average long-term increase in the market.[23] Due to the extremely low scrap volumes in 2005–08, a backlog of vessels ready for scrapping is also added to account for that anomaly.[24] The backlog of 28 million GT is added in a short burst in 2009–11 with 10 million, 10 million, and roughly 8 million GT, respectively. (see Figure 3.2)

The single-hulled tankers with a combined tonnage of 24 million GT are due for a regulated phase-out under the IMO in 2010, and a phase-out profile is given with an early start in 2009 and a quick phase-out of

[23] Martin Stopford, Clarkson Research, presentation in Copenhagen, 1 October 2009.
[24] Annual "missing" scrap tonnage = Average yearly scrapped tonnage (1992–2004) - Actual scrapped tonnage

all the regulated tonnage in the three years leading to 2012. The fraction of backlog and the single-hulled tanker phase-out is divided and added to Bangladesh and Pakistan on the basis of their respective shares of world scrapping volume in 2008. Thus, the projected profiles of the countries involved in recycling are similar to the global projection, although not in absolute numbers.

Figure 3.2 Global historic recycling volume 2000–09 and projected recycling 2010–30 in million GT

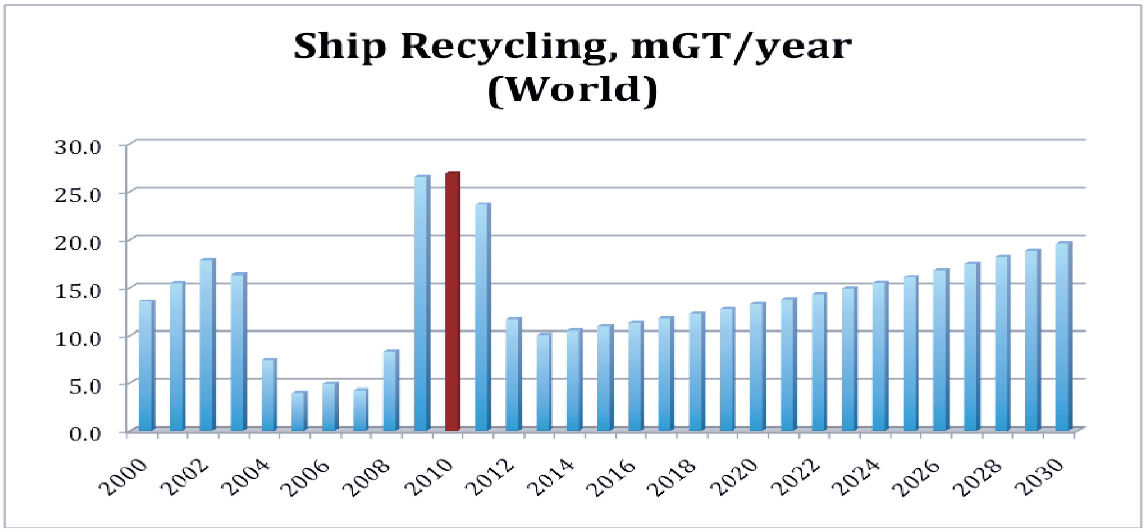


Table 3.2 provides data for accumulated recycling for the next 20 years for global recycling volume in the two countries of the study. These accumulated tonnages are used to estimate the amount of hazardous materials imported and are based on both the latest full year available data for 2008 and the accumulated data distribution from 2000 to 2008. No distinction has been made between the types of merchant ship or place and year of build due to insufficient data availability for the hazardous materials by these categories. Although the market profiles of the recycling nations are slightly different, with Bangladesh and, to a lesser extent, Pakistan scrapping mostly tankers, both countries are treated alike for this study. The projected global volume of scrapping is based on an annual 4 percent increase in fleet size, as noted earlier, but since the annual volume in 2008 is slightly less than the average annual volume for 2000–08, the projected accumulated global recycled tonnage differs in the two estimates.

Table 3.2. Tonnage scrapped globally and in Bangladesh and Pakistan, 2010-30

	Accumulated tonnage scrapped 2010–30 (mGT)	
Location	**Distribution based on 2008 data**	**Distribution based on 2000–08 data**
Global	320	388
Bangladesh	162	130
Pakistan	10.2	22.9

The global volume of naval vessels to be decommissioned over the next 20 years cannot be predicted, as political decisions are far more important for the lifetime of warships than their age (which is typically decisive for merchant vessels). The destination of warships decommissioned from a nation's navy may be another (friendly) nation's navy, the vessels may be scrapped nationally, or they may be used for artificial reefs or target practice. In the European Union (EU), the annual decommissioned volume is estimated at 40,000 LDT, which is assumed to be approximately 1 percent of the merchant fleet volume.[25] Table 3.3

[25] European Commission 2007.

shows the projected accumulated hazardous materials imported in scrapped merchant vessels to the three countries for 2010–30. This is based on the available data for the materials listed in the IHM Parts I, II, and III.

Table 3.3. Accumulated hazardous waste amounts in Bangladesh and Pakistan, 2010–30*

Hazardous material	Unit	Bangladesh**	Pakistan**
Asbestos	ton	79,000 (62,000)	5,200 (11,700)
PCB*** (mainly in cables)	ton	240,000 (192,000)	16,000 (36,000)
ODS (mainly in PU foam)	ton	210,000 (168,000)	14,000 (32,000)
Paints (metals, TBT, and PCB)	ton	69,200 (59,800)	4,550 (102,000)
Heavy metals****	ton	678 (542)	45 (101)
Waste liquid organic	m^3	1,980,000 (1,580,000)	130,000 (292,000)
Miscellaneous (mainly sewage)	m^3	107,000 (85,600)	7,000 (15,700)
Waste liquids, inorganic (acids)	ton	775 (620)	51 (115)
Reusable liquids, organic	ton	675,000 (540,000)	44,200 (99,500)

*Based on Tables 3.1 and 3.2. **Country distribution based on 2008 and 2000–08 data (in parentheses). ***The values given for PCB correspond to the amounts of contaminated materials, which must be treated as hazardous waste under the proposed IMO regime. The actual PCB content based on 1,500 ppm in cables corresponds to 360 tons in Bangladesh and 24 tons in Pakistan. ****Mainly batteries, bearings, and anodes.

Fate of hazardous materials imported in ships for recycling

Some hazardous materials are exposed during dismantling and managed (or spilled) on the spot, but a great number of different materials in considerable amounts are carried with equipment off the yards. This material may re-enter society in disguise (wall panels with asbestos were used in furniture displayed at a roadside shop outside Chittagong, for instance) or simply travel into the hinterland with the motors, cables, transformers, A/C systems, and other items reused in both countries.

Table 3.4 provides the principal disposition of the hazardous wastes. Some materials will be separated and disposed of as waste at authorized facilities, but many of the materials are associated with the products, such as paint on steel for rerolling and equipment for resale, such as pumps, motors, and transformers. The hazardous materials will thus become more widely distributed and will be further spread into the environment, particularly when subject to additional processing. Assumptions have been made to illustrate the potential distribution of these materials by estimating the partition between different destinations: the yards, the re-rolling mills, waste treatment facilities (where known to exist), and other destinations not specified, which may include informal, unauthorized disposal. The assumptions are mainly based on whether the product has a further use in the given country. A small amount of halons (an ozone-depleting substance or ODS) will be found in fire-fighting equipment (if left sealed), whereas the majority will be in foam, so only a small amount of total ODS is allocated to equipment. The ODS in foam will be widely distributed depending on any secondary use made of the foam, hence this ODS has an "unknown" destination and may remain a pollution factor for years to come.

Table 3.4. Principal disposition of hazardous wastes from Bangladesh's and Pakistan's ship breaking and recycling industry, 2010–30. (Based on a business-as-usual scenario using 2008 data)

Hazardous material (unit)	Remain at yard/ in beach sediment	Sold with equipment or as item	Re-rolling mills	Waste disposal site (formal)	Unknown or informal waste disposal site
Bangladesh					
Asbestos (t)	37,525	3,950	0	0	37,525
PCB mainly in cables (t)	24,000	216,000	0	0	0
ODS (PU foam) (t)	42,000	2,100	0	0	165,900
Paints (metals, TBT, PCB) (t)	3,460	3,460	58,820	0	3,460
Heavy metals (t)	169.5	169.5	339	0	0
Waste liquid organic (m^3)	1,978,000	0	0	0	0
Miscellaneous (sewage) (m^3)	107,000	0	0	0	0
Waste liquids inorganic (t)	193	389	0	0	193
Reusable liquids organics (t)	33,750	607,500	0	0	33,750
Pakistan					
Asbestos (t)	4,940	260	0	0	0
PCB (mainly in cables) (t)	1,600	14,400	0	0	0
ODS (PU foam) (t)	13,860	140	0	0	0
Paints (metals, TBT, PCB) (t)	455	228	3,867	0	0
Heavy metals (t)	22.5	22.5	0	0	0
Waste liquid organic (m^3)	130,000	0	0	0	0
Miscellaneous (sewage) (m^3)	7,000	0	0	0	0
Waste liquids inorganic (t)	25.5	25.5	0	0	0
Reusable liquids organics (t)	2,210	39,780	0	0	2,210

These estimates assume that no new waste treatment capacity comes on stream, that existing ship breaking practice remains unaltered, and that the materials themselves are distributed according to proportions assigned to them. Further releases to the environment may occur during any downstream processing, depending on the state of pollution control mechanisms in use, such as the air pollution control at re-rolling mills.

Much of the material assumed to remain on the beaches will be due to the quality of yard housekeeping practices, allowing spillages and leakages of hazardous materials or their escape during normal handling—for example, torch cutting of painted metals not mechanically cleaned before cutting. The lack of hazardous waste disposal and treatment facilities in Bangladesh and Pakistan means that wastes produced must nevertheless be disposed of somewhere. Therefore informal disposal may also occur on the beaches themselves, on adjacent unused plots, or on other nearby land.

On the basis of the above projections, key areas of concern include the following.

Asbestos is a concern because of its occurrence on many vessels, its detrimental effect on workers from exposure, and the slow phase-out profile. The sheer volume of more than 40,000 tons that is likely to be produced is a significant challenge for occupational exposure, although environmentally speaking asbestos is not a major problem.

PCBs are of concern because the projections, in particular regarding cables and hydraulic/lube oil, suggest a massive volume of hazardous materials. There are too few data to dismiss PCBs as a problem of the past. In the years ahead the majority of vessels built in the late 1970s and 1980s will be recycled and many of these may contain large amount of PCBs. The distribution of used equipment throughout the countries, with their components potentially containing PCBs, also requires attention.

Ozone-depleting substances are being phased out for uses onboard, particularly for refrigeration and fire extinguishing. They are relatively simple to identify and to properly collect and store in an environmentally sound manner. However, ODS used as blowing agents in the formation of foam for insulation are structurally embedded in many ships, and the waste, which must be designated as hazardous, is voluminous. The proper management of the recycling or disposal of polyurethane foam containing CFCs should be given priority in addition to the suitable collection and management of CFCs in refrigerant and fire extinguishing systems. Many of these substances also have substantial global warming potential.

In addition, the following materials and waste fractions are also problematic in the ship breaking context.

Paints and other coatings often contain high levels of lead, TBT, and frequently chromates, cadmium, and PCBs or asbestos. When plates are cut and re-rolled, these chemicals are released into the atmosphere. Proper identification of the content in paints can reduce occupational exposure.

No analysis of other **persistent organic pollutants** (POPs**—**dioxins or furans) could be carried out in the countries studied. The practice of burning cables to obtain copper generates significant dioxin concentrations, although it is technically simple to manage and curtail. In the re-rolling mills, the low temperature heating of painted steel plates (in particular, those painted with chlorinated rubber paints) is also conducive to dioxin generation, and little information is available on this source.

Metals from batteries, anodes, and various other high-risk equipment such as bearings can be retrieved relatively easily and recycled or disposed of. Proper identification, management, and capacity building for their safe handling can minimize any problems.

Liquids with hazardous properties, be they sewage, bilge, or reusable liquids (solvents, fuel etc.), are not managed safely today. This problem could be addressed with relatively simple means.

3.2 Baseline environmental conditions at SBRI yards

Conditions at ship recycling yards in Bangladesh

Only a few studies have been conducted on the impact of ship recycling at Chittagong and the majority of those, especially from academic sources, relate to the marine environment and sediments, including biotic indicators. The marine pollution reports mainly give spot values, with little indication of pollution plumes or gradients, as typically shown by Khan and Khan (2003).

In the recent past, a comprehensive review of the conditions at Chittagong ship recycling yards was undertaken by Det Norske Veritas (DNV) for air, water, sediment, and soil samples.[26] For comparison purposes, data reported by DNV from soil values from a steel plate reprocessing site at the Kanpur-Unnao area of India is used as local natural background values. These background levels were given as:

Cadmium (Cd) mg/kg 0.1
Chromium (Cr) mg/kg 114
Lead (Pb) mg/kg 144
Mercury (Hg) mg/kg 0.05 - 0.2

DNV reported elevated levels of heavy metals in the sediments around the ship recycling yards (see Table 3.5). , No PCBs and TBT were detected possibly due to tidal effects washing out any traces. However, soils from a steel plate manufacturing location contained PCBs ranging from 42 to 108 µg/kg. Although

[26] DNV 2000.

these values cannot be directly correlated to conditions at the beaching yards, it may be assumed that these substances would also be found at the yards where the plates were cut, and therefore soil contamination would be expected.

Table 3.5. Heavy metal concentration in the sediments of ship breaking sites in Bangladesh

Sampling stations	Trace metal concentration (µg/g)							
	Fe	**Cr**	**Ni**	**Zn**	**Pb**	**Cu**	**Cd**	**Hg**
Salimpur	12	68	23	84	37	21	0.57	0.02
Bhatiari	35	87	35	102	122	40	0.83	0.02
Sonaichhari	41	78	49	143	148	31	0.94	0.12
Kumira	21	23	25	120	42	28	0.59	0.05
Sandwip (control site)	3	19	4	22	9	2	0.19	0.02

Source: Hossain and Islam 2006.

The 2005 PCB inventory survey for the Stockholm Convention National Implementation Plan (NIP) estimated that Bangladesh had some 56 tons of PCBs, of which ship breaking was estimated to contribute 22.5 tons. This was assessed based on data for 1999–2004, when some 90 ships per annum were scrapped with each merchant ship containing 250–800 kilograms of PCBs (including transformer oil and paint chips). Bangladesh has limited capacity for laboratory analysis of PCBs, and no specific legislation in place for persistent organic pollutants. No national inventory of contaminated sites was carried out at the time of publication of the PCB inventory report, and it was noted that "shipyards" (referring to ship recycling) near Sitakunda, Chittagong, may be contaminated with PCBs. There was no monitoring program in place for POPs.

The NIP cited only one known study that had investigated the presence of PCBs at ship recycling yards, that by DNV, which showed elevated levels from 0.2 to 1.444 mg/kg compared with a reference background value for Norway (there being no reference for Bangladesh) of 0.003–0.03 mg/kg. The NIP also noted from the same study that "four marine sediment samples taken from the inter-tidal zone (up to 600 meters from the ship breaking site) were analyzed for PCB and none were found."[27]

Litehauz investigations at three yards in Chittagong showed a range of heavy metals, oils, and asbestos, but not PCBs. The results shown in Tables 3.6 and 3.7 are consistent with the findings of Hossain and Islam (2006) on marine sediments. The values for metals investigated by Litehauz are compared with the sites examined by Hossain and Islam (averaged) in Table 3.7. These data indicate widespread general contamination of the soil at beaching yards investigated in Chittagong. This is expected to be typical of many yards where beach dismantling activities are unconfined and the ground is not protected. (See Appendix 6)

[27] Ibid.

Table 3.6. Soil metal concentration at three ship yards at Chittagong, Bangladesh, August 2009 (mg/kg; samples from present study)

Yard 1	**Soil 1**	**Soil 2**	**Soil 3**	**Soil 4**	**Soil 5**
Lead (Pb)	248	898	77	450	229
Cadmium (Cd)	2.2	n.d.	n.d.	n.d.	n.d.
Chromium (Cr)	157	180	66	138	123
Mercury (Hg)	0.1	0.2	0.05	0.10	0.2
Yard 2	**Soil 1**	**Soil 2**	**Soil 3**	**Soil 4**	**Soil 5**
Lead (Pb)	206	217	334	138	262
Cadmium (Cd)	0.6	n.d.	n.d.	n.d.	n.d.
Chromium (Cr)	169	160.0	152	134	149
Mercury (Hg)	0.2	0.3	0.3	n.d.	0.2
Yard 3	**Soil 1**	**Soil 2**	**Soil 3**	**Soil 4**	**Soil 5**
Lead (Pb)	212	151	274	174	154
Cadmium (Cd)	n.d.	n.d.	n.d.	n.d.	n.d.
Chromium (Cr)	143	192	178	238	180
Mercury (Hg)	0.3	BDL	n.d.	0.2	0.1

n.d. not detected. BDL below detection level

Table 3.7. Soil metal concentration at selected points in ship recycling yards at Chittagong, Bangladesh, August 2009(mg/kg). (Samples from present study)

Yard 1	**Hot Spot 1**	**Hot Spot 2**
Lead (Pb)	313	128
	n.d.	n.d.
Chromium (Cr)	175	164
Mercury (Hg)	n.d.	0.1
Yard 2	**Hot Spot 1**	
Lead (Pb)	319	-
Cadmium (Cd)	1	-
Chromium (Cr)	137	-
Mercury (Hg)	0.1	-

n.d. not detected

It is found that the anticipated hot spot areas are as contaminated as the rest of the samples from the yard. Tables 3.8 and 3.9 provide a summary of the ranges found in comparison with action levels for contaminated land. They indicate that the ship recycling yards at Chittagong are contaminated to levels typical of industrial uses, which would trigger a need for further investigation and remediation to make them safe for other uses, such as anything involving residential or agricultural activity. The uncertainties about the presence and distribution of PCBs and asbestos require more detailed studies to identify the locations and establish an appropriate remediation strategy.

Table 3.8. Metal concentration at ship recycling yards at Chittagong, Bangladesh, compared with action levels for soils and marine contaminated dredging
(Samples from present study)

Parameter	Range Lower (mg/kg)	Range Upper (mg/kg)	Background Soil (mg/kg)	Average Hossain (mg/kg)	Action Level Marine*	Action Level Soil**
Lead (Pb)	151	898	<50	87.25	40–200	450–750
Cadmium (Cd)	n.d.	2.2	0.39	0.73	0.4–2.5	1.8–230
Chromium (Cr)	66	238	39.3	64	50–270	130–5,000***
Mercury (Hg)	n.d.	0.3	0.13	0.052	0.25–1	1.0–26

Col. 5: Average of values from Table 3.5 sampling stations affected sites. n.d. not detected.
* OSPAR Commission 2008. ** Soil Guideline Values, Environment Agency UK, lower limit for sensitive areas (such as gardens), upper for commercial uses; 2009 data except as stated. *** Defra 2002.

Table 3.9. PCB, oil, and asbestos concentrations at ship recycling yards in Chittagong, Bangladesh, compared with action levels for soils and marine contaminated dredging

Parameter	Range Lower (mg/kg)	Range Upper (mg/kg)	Background Soil (mg/kg)	Action Level Marine	Action Level Soil
PCBs (μg/kg)	n.d.	n.d.	1	20–200	8.0–240*
Asbestos fibers/g	2	400	-	-	-
Oil and grease %	0.32	4.43	-	-	-

For references, see Table 3.8. n.d. not detected. * Soil guideline values for sum of polychlorinated dibenzodioxins), polychlorinated dibenzofurans, and dioxin-like PCBs.

Conditions at ship recycling yards in Pakistan

Few studies exist of the ship recycling area at Gadani Beach in Balochistan. Case studies for environmental impact assessments for specific ships recognize that the beaches have become contaminated by recycling activity, although the parameters measured are limited to grease, oil, and bacteria and do not generally report on heavy metals, PCBs, or TBT. The investigations of sampled beach material for site characterization assessments conducted for this study show the presence of chromium, lead, and mercury but not cadmium. (see Table 3.10) The concentrations ranged from 2.42 to 22.12 mg/kg for chromium, from 11.3 to 197.7 mg/kg for lead, and from 0.078 to 0.158 mg/kg for mercury. These values are comparable to those found in marine sediments at Chittagong, Bangladesh.[28]

Asbestos was not found at the one site for which samples were analyzed. This is not surprising, as it is understood that burial on-site is a common practice, although the locations are not marked. The surface samples taken may not have disturbed a lower-lying asbestos-containing layer. PCBs were found to be widely distributed over the yards sampled, with concentrations varying from 0.01 to 11.52 ppb. (see Table 3.11) There was no overall pattern discernible, with concentrations being higher across the yard than at a selected "hot spot." This is consistent with cutting and other activities being carried out at multiple locations without preventive measures to control releases to the soil. In a separate exercise, tin was measured as indicative of the presence of TBT on paint samples. This is not conclusive, but the evidence from the ship samples (paint chips) indicates that further confirmatory work should be done on sediments and soils at the yard, specifically to examine the presence of TBT. Oil was found in all samples tested, ranging from 485 mg/kg to 4,300 mg/kg, indicating general contamination.

[28] Hossain and Islam 2006.

Table 3.10. Metal concentrations at ship recycling yards in Gadani, Pakistan, compared with action levels for soils and marine contaminated dredging

Parameter	Range Lower (mg/kg)	Range Upper (mg/kg)	Background Soil (typical)	Action Level Marine	Action Level Soil
Lead (Pb)	11.3	197.7	<50ppm	40-200	450-750
Cadmium (Cd)	BDL	BDL	0.39	0.4-2.5	1.8-230
Chromium (Cr)	2.42	22.12	39.3	50-270	130-5,000
Mercury (Hg)	0.078	0.158	0.13	0.25-1	1.0-26

BDL below detection level. For references, see Table 3.8

Table 3.11. PCBs, asbestos, and oil at ship recycling yards in Gadani, Pakistan, compared with action levels for soils and marine contaminated dredging

Parameter	Range Lower (mg/kg)	Range Upper (mg/kg)	Background Soil (typical)	Action Level Marine	Action Level Soil
PCBs (µg/kg)	0.01	11.52	1	20-200	8-240
Asbestos	n.d.	n.d.	-	-	-
Oil (mg/kg)	485	4300	-	-	-

For references, see Table 3.9

These investigations confirm the likely widespread variable contamination of the ship recycling yards at Gadani beach with chromium, lead, and mercury—although not at levels as high as those found at other ship recycling areas in the region. Contamination with oil and PCBs but not TBT was found. Further work would be needed to quantify the distribution of these substances and to determine the location of any asbestos materials. Only modest decontamination procedures might be needed to restore the sites for other uses.

Overall baseline conditions at ship recycling yards in Bangladesh and Pakistan

There is widespread varying contamination of the ship recycling yards at Chittagong (Bangladesh) with cadmium, chromium, lead, and mercury and less contamination at Gadani (Pakistan). Values found in the site characterization assessments range from 0.6 to 2.2 mg/kg for cadmium, from 2.42 to 22.12 mg/kg for chromium, from 11.3 to 197.7 mg/kg for lead, and from 0.078 to 0.158 mg/kg for mercury. Oil was found in all samples tested, ranging from 485 to 4,430 mg/kg. Oil aside, these results are consistent with previous studies on marine sediments in the vicinity of the yards. Significant restoration/decontamination would be required at Chittagong to allow for any change of land use and to prevent loss of the pollutants to the sea in the event of sea level rise, leading to contamination of other vulnerable areas, such as fisheries and hatcheries.PCB concentrations vary from 0.01 to 11.52 ppb. Treatment and disposal of POPs waste, especially PCBs, is beset with difficulties due to the lack of suitable treatment facilities and the need for a reliable low-cost PCB detection method.

In the context of alignment with the Stockholm Convention, the Basel Convention has adopted a guideline covering all aspects of PCB waste management, including identification, handling, storage, and environmentally sound disposal of PCB wastes. Two documents are relevant, a general one on POPs waste management and the specific PCB Guideline.[29]No analysis of other POPs (that is, dioxins or furans) was carried out in the three countries. The practice of burning cables to obtain copper (which may be less common today) generates significant dioxin concentrations, and in the re-rolling mills the low-temperature heating of painted steel plates is conducive to dioxin generation.

[29] Both available at www.basel.int/meetings/sbc/workdoc/techdocs.html.

3.3 Sea level rise

Global climate models predict a sea level rise with climate change caused by global warming. A parallel process of land subsidence, as presently occurring in some areas in Bangladesh would further exacerbate the effects of such sea level change. A major cause of such sinking is groundwater and gas extraction, and building of dams and human-made channels that divert sediment.[30] These effects increase the vulnerability of coastal areas to storm surges, which are correlated with increases in sea surface temperature and common in cyclonic regions such as the Bay of Bengal.[31] Such surges can give rise to temporary increases in sea level of 3–10 meters.

The physical impacts of climate change in coastal area thus include a regression of the shoreline and the undermining of buildings by erosion. The higher tide level on the beaches would also cause the pollutants contained in the submerged sand in ship breaking areas to be washed out under wave actions, increasing the impact of existing industrial pollution. This is already acknowledged in Chittagong, where ship breaking is recognized in the national action plan as a source of pollution, contributing to industrial pollution generally in the area.[32]

The 2007 synthesis report from the Intergovernmental Panel on Climate Change presented an estimate of sea level rise of between 0.21m and 0.48m, based on peaking of carbon dioxide emissions in 2015.[33] Estimates of the expected amount of sand that could be washed out from the beaches in Chittagong and Gadani by this are provided in Table 3.12. This sea level rise estimate is conservative and is based on a faster control of carbon emissions than most experts expect following the 2009 Copenhagen Summit. The redistribution of metals and persistent pollutants from the relative immobilization in soils to the dynamic aquatic ecosystem of the coastal zone is generally not desirable, since fish and shellfish in particular accumulate and transfer the pollutants into human and environmental food chains.

Table 3.12. Volume of sand to 0.2m depth under water with predicted sea level rise

Beach	Slope and length	Polluted sand under new high tide (sea level rise 0.21–0.48 m)
Chittagong, Bangladesh	0.05; 13 km	11,000–25,000 m^3
Gadani, Pakistan	0.08; 7 km	3,500–8,100 m^3

Source: IPCC 2007 (A1B scenario).

This will result in the spread of polluted sand from current and past ship breaking activities. Table 3.13 indicates the amount that may be washed out above the background levels.

[30] Syvitski et al., 2009.
[31] Aggarwal and Lal 2001.
[32] Department of Environment 2006.
[33] IPCC 2007.

Table 3.13. Pollutants submerged with predicted sea level rise (in kg)

Chittagong	**Low estimate (0.21m)**	**High estimate (0.48m)**
Lead (Pb)	5,049.3	11,541.3
Cadmum (Cd)	25.8	58.9
Chromium (Cr)	2,723.5	6,225.1
Mercury (Hg)	3.2	7.3
Gadani		
Lead (Pb)	646.9	1,478.6
Cadmium (Cd)	0.0	0.0
Chromium (Cr)	94.2	215.3
Mercury (Hg)	0.7	1.6
PCB (ppb)	46.9	107.3
Total Oil	13,713.7	31,345.6
Asbestos	0.0	0.0

These pollutants will combine with other runoff from industrial discharges, affecting areas of biodiversity and economically important areas such as fisheries and fish and shrimp farms. In storm surge events, a sudden release of the contaminated landside beach material into the marine zone may affect local fisheries severely (see Table 3.14)

Table 3.14. Qualitative impacts of predicted sea level rise on ship recycling yards and coastal residential areas

Event	Impact	Effect	Mitigation
General sea level rise	Tidal erosion of beaches	Loss of beaching facility	Coastal protection works
Storm surges	Damage to infrastructure	Yard buildings undermined and lost	
	Loss of coastal roads	Roadside shops destroyed	Relocation
		Roadside community dwellings submerged	Relocation
Higher tides	Release of heavy metals, TBT, and PCBs from beach into the coastal environments	Fisheries and shrimp hatcheries poisoned	Preemptive de-pollution or stabilization of contaminated areas

3.4 Addressing national and international environmental compliance requirements

Compliance gaps between existing practices and the Hong Kong Convention will arise for two main reasons: a disparity between current practice and the standards envisaged under the Convention and the absence of agreed standards while the new guidelines to support the HKC are in preparation. (See Appendices 3, 7, and 8 for more information.)

Value of other instruments and guidelines

The ultimate objective will be the implementation of the International Convention for the Safe and Environmentally Sound Recycling of Ships in each country. However, other relevant international instruments implemented in national law have linkages with the SBRI as well. These instruments include the Basel Convention of 1989 on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, the Stockholm Convention of 2001 on Persistent Organic Pollutants, and the Montreal Protocol of 1987 on Ozone Depleting Substances, as well as occupational safety and health issues that are covered by agreements under the International Labour Organization (ILO). All these support the necessary infrastructure for environmentally sound and safe management of hazardous materials and wastes associated with ship recycling.

A number of guidelines made pursuant to these agreements and instruments have already been published, some with specific application to the SBRI. They include the Basel Convention Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships, the ILO Safety and Health in Ship-breaking Guidelines for Asian Countries and Turkey, and the IMO Guidelines on Ship Recycling. Use of these guidelines can also contribute to national transitional strategies toward implementation of the Hong Kong Convention, especially while that Convention's own guidelines are being developed and before it enters into force. The Regulations in the Annex to the Hong Kong Convention reference the ILO, IMO, and Basel Guidelines "to be taken into account" in developing new guidelines.

The following assessment of country positions provides a non-comparative summary of gaps identified in the regulatory infrastructure that will need to be addressed to fully implement the Hong Kong Convention.

Bangladesh

Issues and gaps in Institutional approach

The SBRI in Bangladesh is not yet officially recognized as a formal industry, with little application or enforcement of industrial laws in this sector. However, a number of departments have separate overseeing role of the various activities undertaken by the SBRI.

- Many of the ship breaking yards are ,registered with the Department of Inspection for Factories and Establishment as a factory. A No Objection Certificate (NOC) is required from the Department of Shipping before a ship can be beached. The Department of Labor has responsibility for enforcement of the Bangladesh labor laws. This happens rarely, most probably due to the unofficial status of the industry.

- The Explosives Department inspects a ship twice (once at outer anchorage and once after beaching) and provides a "gas free certificate" in accordance with the Bangladesh Petroleum Act. Where the appropriate notification is provided, inspections are made for a fee.

- The Department of Environment (DOE) is responsible for facilities authorized under the Environment Conservation Rules of 1997. Facilities are required to apply for an Environmental Clearance Certificate, detailing the process and measures taken. This is applicable to all new industries and projects. Industries are classified according to their potential impact on the environment into four categories: Green, Orange-A, Orange-B, and Red. Green industries are automatically granted a clearance certificate. Orange categories must submit further information and plans and may be subject to field inspection. Highly polluting categories, Orange-B and Red, must in addition conduct a detailed Environmental Impact Assessment and prepare environmental management plans satisfactory to the Department. The DOE is believed to have categorized ship breaking activities as Orange-B. No authorizations have yet been issued. As a result, few inspections are made at the yards.

In March 2009 the High Court directed the government of Bangladesh to close all ship breaking yards that run without clearance from the DOE[34] within two weeks. The order followed a writ filed by the Bangladesh Environment Lawyers Association in September 2008. The court ordered the formulation of

[34] The court order is summarized as: "*Uncertified ship-breaking operations must close within two weeks;• Ship-breaking operations must obtain environmental certification before operating in Bangladesh; • Ships must be cleaned of all hazardous materials before entering the country; and • Ship-breaking operations must guarantee safe working conditions for workers and environmentally sound disposal plans for wastes.*"

rules for the ship recycling sector and for the yards to operate under an environmental clearance certificate. Ship recycling continues while these rules are currently under consideration.

In summary, compliance gaps with the Hong Kong Convention are:

- No recognition of the industry
- No authorizations for yard facilities
- No standards or guidelines applied to ship recycling
- Low level of application of health and safety practices
- Few inspections

Industry Infrastructure

Hazardous waste management facilities for wastes such as PCBs, asbestos, and so on are not available. Some of these wastes have either been buried on site or disposed of informally elsewhere.

Approach to upgrading of SBRI facilities

There appears to be low operator awareness of the Hong Kong Convention and its requirements. Addressing this must be a priority to enable satisfactory implementation of the Convention. At this stage, upgrading does not appear to be a priority in the plans of yard owners. The general lack of formal working areas and absence of clear zoning and containment lead to uneven accumulations of wastes and materials and to spillages on bare ground. However, some yard operators are working to upgrade their facilities gradually by introducing mechanization to reduce the extent of manual loading and by excavating the ground to keep the beach fit for beaching. One yard has obtained an ISO 9001 certificate, and several other yards are following that route.

Institutional gaps: Needs for partial and full implementation

There are significant gaps to be addressed in order to implement the Hong Kong Convention in Bangladesh. As a first step, regulations for ship recycling would need to become national laws.

Upon ratification of the HKC, a competent authority needs to be designated that will authorize and inspect ship recycling facilities. In particular, regulations 15–23 of the Hong Kong Convention require Parties to establish legislation, regulations, and standards that are necessary to ensure that ship recycling facilities are designed, constructed, and operated in a safe and environmentally sound manner in accordance with the regulations in the Convention.

An authorization process is required with inspection monitoring and enforcement provisions, including powers of entry and sampling. The ship recycling facilities need to establish management systems, procedures, and techniques that do not pose risks to the workers concerned, to neighbors, and, to the extent practicable, to the environment, taking into account guidelines developed by the IMO.

Regulations 24 and 25 of the Convention establishes notification procedures concerning the intention to recycle a ship so that final surveys may be arranged and specified information may be provided to the competent authority. A Statement of Completion has to be issued by the facility to that authority when the ship has been recycled. These procedures can be introduced in a stepwise fashion, building capacity both before and during the national legislative process.

Indicators for assistance interventions

The activities identified to assist with improvements in ship breaking and recycling conditions and standards and implementation of the HKC in Bangladesh come under the following headings and types of actions:

Institutional capacity building

- Assistance to government departments with respect to implementation of compliance measures for the Convention
- Technical assistance and funding to develop the competence of the inspectors from different departments and to provide instrumentation and training for facility personnel in using gas monitors for "confined space entry" and "safe for hot work"
- Training of personnel to establish a competent authority

Supporting infrastructure

- Technical assistance and funding to develop a modern laboratory for environmental monitoring
- Technical assistance and funding to develop a waste reception facility for environmentally sound disposal of hazardous materials and wastes

Facility development–technical/infrastructure:

- Technical assistance to prepare cost-effective procedures to prevent environmental pollution
- Technical assistance and funding to develop and run a permanent training center for the workers to increase their technical skills, develop awareness regarding hazards and risks involved with their work, and train competent personnel who can develop and maintain a Ship Recycling Facility Management Plan
- Technical assistance and funding for increased mechanization of the existing ship recycling process
- Assistance to establish a fire brigade with trained personnel and medical treatment/first aid facilities in the ship recycling zone

Facility development–managerial:

- Technical assistance to develop model management systems, procedures, and techniques that can prevent health risks to the workers concerned and the people living in the vicinity

The above goals are achievable given the ground realities in Bangladesh. Implementation of these programs can thus bring Bangladesh into compliance with the HKC in an orderly manner.

Pakistan

Issues and gaps in Institutional approach

At present, the main regulatory requirement is the No Objection Certificate issued by the Balochistan Environmental Protection Agency (BEPA) before beaching and breaking can commence. The NOC is issued after submission of an impact assessment. Either an initial environmental examination is performed and submitted to the federal agency or, where the project is likely to cause an adverse environmental effect, an environmental impact assessment is carried out and approval is obtained from that agency.

New legislation would be required for compliance with the Hong Kong Convention as outlined for Bangladesh. In particular, national regulations are needed for compliance with the safe recycling guidelines. A competent authority needs to be established (which may be BEPA) for authorizing ship recycling facilities and the Ship Recycling Plan.

Industry Infrastructure

Pakistan does not possess much hazardous waste treatment capacity. A 1997 World Bank report on Private Sector Participation in Urban Environmental Services noted the lack of facilities to treat hazardous/industrial wastes. This hardly changed in the next 10 years, as Mahar made similar observations in

2007.[35] Any program that addresses implementation of the Hong Kong Convention for downstream treatment of wastes in Pakistan will also need to consider how to manage the general lack of hazardous waste facilities.

Approach to upgrading of facilities

The Ship Breakers' Association is open to dialogue and keen to learn about the HKC. In terms of action, while the Convention is still at an early stage in its life cycle, the approach of the industry is to maintain a watchful eye without taking any preparatory steps.

Institutional gaps: Needs for partial and full implementation

The World Bank Strategic Country Environmental Assessment for Pakistan noted the efforts made to develop environmental legislation but also the low level of regulatory resources: "the adequacy and capacity of staff remains a continuing challenge." Research for this study indicates that this is still the case, and it is likely that ship recycling is one among many other priorities.

Pakistan's recently submitted Stockholm Convention National Implementation Plan (15 December 2009) makes no mention of ship recycling, even in the section on industry in Balochistan. The NIP recalls that there is no specific law on polychlorinated biphenyls. Legislative proposals in the NIP include a ban on the import of PCBs while not recognizing the potential implications for ship recycling (in contrast to the very large burden of PCBs ascribed to ship recycling in Bangladesh in that country's Stockholm NIP). Consideration needs to be given to this aspect in developing Pakistan's environmental legislation to ensure that all POPs are appropriately controlled.

Indicators for assistance interventions

The following activities were identified to assist with improvements in ship breaking and recycling conditions and standards and implementation of the HKC in Pakistan.

Institutional capacity building:

- Technical assistance for enhancing capacity of the Ministry of Environment and provincial Environmental Protection Agencies for adherence and compliance with various articles of the Convention
- Technical assistance in establishing a competent authority
- Assistance in drafting legislation, regulations, and standards for safe recycling facilities
- Technical assistance in implementing regulations and standards at ship recycling facilities

Supporting infrastructure:

- Provision of a disposal facility for hazardous materials and wastes from ship recycling in an environmentally sound manner

Facility development—technical/infrastructure:

- Assistance in implementing guidelines for inspection of ships before beaching

Facility development—managerial:

- Establishment of guidelines and procedures to prevent adverse effects on human health

[35] Mahar et al. 2007.

Figure 3.3 A ship-recycling yard in Gadani, Pakistan

Photograph courtesy of Susan Wingfield, 2009

3.5 Compliance with the Hong Kong Convention

Bangladesh and Pakistan both possess some form of a basic control mechanism for ship recycling, which is usually based around the "no objection" concept. However, this does not meet many of the requirements adopted under the HKC.

The HKC is at the early stages of implementation, although the text of the Convention has been finalized. At the international level, a considerable amount of continuing development work is necessary to bring to a conclusion the first part of this implementation process. This includes the drafting and negotiation processes at the IMO to develop and finalize texts of the guidelines, which are key products for operation of the Convention. The guidelines, for example, will elaborate much of the technical details for operating a recycling facility in a safe and environmentally sound manner.

The ratification of the convention by states and its subsequent entry into force when the conditions are met will take several years while governments make the necessary preparations. There is evidence that such steps are already being undertaken by some actors in the shipping industry and by some states. The Diplomatic Conference Resolutions also envisaged an intermediate process for improving standards through technical assistance and cooperation, mirroring that of Convention Article 13 and in support of the general technical cooperation work of the IMO on training and capacity building. These actions will offer a further incentive for those in a position to provide assistance.

All these actions are directed toward bringing the Convention into force over time. In the short to medium term, it can be expected that further action to facilitate and promote practices consistent with the provisions of the Convention will progress through the mechanisms described in this chapter.

4 Improving Environmental Performance: Proposed Strategy and Actions

The ship breaking industry in South Asia can look back on 25–30 years of activity with very little global competition. This is a significant period of time in comparison with the history of other ship breaking destinations such as Taiwan, Korea, or, even earlier, Japan, which only maintained dominance in the market for 10–15 years. China has, over the same time span, entered and exited the market several times, always offering slightly less competitive prices.

With the adoption of the HKC, it is inevitable that the countries involved in ship recycling must decide on their future plans, as the crossroad of ratification is approaching. This process was already under way in Bangladesh and Pakistan for a few years during the development of the Convention. In both countries some progress is discernible towards better environmental management that can help in meeting many of the requirements under HKC. In Bangladesh, the High Court has decided on initial procedures toward recognition of the environmental concerns associated with the industry, and in Pakistan, authorities have new legal instruments to allow assessment of the hazardous conditions of end-of-life ships. However, both countries still have some distance to cover to reach a proper EHS management level as the crossroad for conforming to the requirements prescribed under HKC is nevertheless approaching. An early start on an implementation strategy will allow for a less painful transition period and will increase the viability and sustainability of the recycling industry.

This chapter addresses strategies to improve EHS performance while maintaining the continuance of the industry in each country. Although both capacity development and infrastructure improvements are needed, considerable focus on involving industry is maintained and, in particular, the options for public-private partnerships are emphasized. The time to act is opportune during the coming years, as the HKC is expected to enter into force in 2015. The recent accession of both countries to the Stockholm Convention on Persistent Organic Pollutants is also a positive development.

4.1 Strategies and actions

The two South Asian countries responsible for a major share of global ship recycling volume are often portrayed in the media and public opinion as operating under similar conditions. While there are some similarities, there are also considerable differences with regard to the economic, legislative, political climate, or even basic natural conditions. In areas with common problems, there are opportunities for collaboration between the two countries. This collaboration can even be made regional by also including India, the other major ship breaking nation in that region. The proposed recommendations take into account these similarities and differences.

The gap analysis and needs assessment for Bangladesh and Pakistan has shown that the **improvements must address workers' living and work safety conditions, protection of the environment, and upgradation of roads, technical services, and amenities in the ship breaking community**. Furthermore, for future compliance with the HKC, actions are needed regarding the direct upgradation of ship recycling procedures, performance, equipment, and infrastructure in the SBRI. The overarching strategy should aim at achieving this through interventions based on three objectives:

- Reducing the risks/impact to workers and the environment from unsafe dismantling practices in the recycling yards
- Providing safe storage, transport, and disposal options for hazardous materials derived from the recycling process to reduce the distribution of unsafe materials in communities
- Providing options for financing investments and managing them through public-private partnerships.

The upgradation of infrastructure is addressed under each country strategy as a complement to the actions identified for compliance with the Hong Kong Convention. Stronger regulatory regimes and increasing costs have historically relocated the industry. The risk of relocation is therefore assessed based on the impact on the profitability of ship breaking in Bangladesh and Pakistan and the degree of competition from other options for ship breaking.

The economic burden of achieving minimum compliance has been assessed for Bangladesh and Pakistan and is described in the following tables. The estimate is based on the following assumptions: annual costs of operation at 5 percent of the total investment costs, a loan interest rate of 10 percent, and annual recycling activity as in 2008. The burden is assessed on the basis of extra costs per LDT for the period 2010–30, assuming today's market share.

Outline strategy for timed partial and full compliance with the HKC

A timed implementation plan is presented in Table 4.1 for graduated compliance over a 10-year period. Some interventions, such as hazardous waste management facilities, are prerequisites but not specifically mentioned in the HKC. A more detailed discussion of the HKC can be found in Appendix 3. In Appendix 7, an overview of institutional arrangements relevant for the implementation of the HKC and other measures to improve the safety and environmental issues in ship breaking industry can be found. Appendix 10 contains more detailed descriptions of selected actions proposed.

Table 4.1. Outline strategic plan for actions to implement graduated compliance with the Hong Kong Convention*

Time	Institutional Action	HKC Article/ Reg.	Industry/Infrastructure	HKC Article/Reg.
Year 1–2	Draft guidelines for facility operation, local standards from IMO work	***R15***	Worker safety–training and personal protective equipment	***R22***
	Develop facility inspection regime (existing legislation)	***A9***	Prepare plans	
			Emergency preparedness	***R21***
	Establish health and training centers, including training for inspectors		Prevent adverse effects to human health (gas free entry, spill prevention)	***R19***
Year 3–5	Establish interim standards	***R15***	Prepare plans Ship recycling facility	***R18***
	Authorize facilities–simplified version	***R16***		
			Incident reporting etc	***R23***
	Inspect facilities (existing legislation)	***PR***		
			Establish management systems to protect workers and the environment	***R17***
	Establish hazardous waste management facility(ies)			
	Establish laboratory	***PR***	Safe and environmentally sound management of hazardous materials	***R20***
Year 6–10	Ratify Convention	***A 16***	Upgrade facility to HKC guideline standard	***Guidelines***
	Full authorization of facilities	***A4, R16***		***R24***
			Reporting–notify start of recycling	
	Designate competent authority	***R15***		
			Completion	***R25***
	Control violations	***A9, 10***		
	Notify IMO	***R16***		

*It is not necessary to ratify the Convention in order to apply its standards, as the resolutions at the Diplomatic Conference in May 2009 made clear. PR = Prerequisite for applying environmentally sound management.

The upgrade requirements of institutions, industry, and infrastructure listed in Table 4.1 are used to develop country-specific priority actions. Cost estimates for these actions are also determined based on readily available information of costs for similar projects within the country or region. The assistance measures to develop legislative and technical capacity have been established based on a number of actions and assumptions as listed in Tables 4.2 to 4.6.

Table 4.2. Actions and assumptions on hazardous waste treatment facility with environmentally sound management

Included actions	Assumptions
For securing economic viability, facility expected to serve wider market than the ship recycling alone A wide range of hazardous wastes is accepted, including asbestos and hazardous liquids and other waste, such as any relating to Basel Convention, Montreal Protocol (ozone-depleting substances), or Stockholm Convention (POPs) for compliance with environmentally sound management requirements Construction to be to international standards; excludes infrastructure network (e.g., roads) but includes civil engineering on site Facility provides its own hazardous waste landfill for treatment residues as well as wastes delivered Includes all building construction on site, pollution prevention (e.g., for groundwater)	Environmentally sound hazardous waste treatment is required Geology is suitable for hazardous waste landfill Approval for construction is given Landfill engineering mainly consists of installation of synthetic liner, drained to wastewater treatment plant, void created as part of site groundworks Other industries participate Land is brown- or green-field site Hazardous waste, POPs, and ODS all treated Costs are indicative estimates based on equivalent examples

Table 4.3. Actions and assumptions on local hazardous waste facility

Included actions	Assumptions
No major facility available serving other industries Local environmentally sound subunits are developed with on-site waste storage and handling Wide range of hazardous wastes from ships is managed, including asbestos and hazardous liquids and others, for compliance with environmentally sound management requirements of HKC Construction to be to international standards; excludes infrastructure network (e.g., public highway network) but includes civil engineering on site Facilities obtain external energy, water supply Includes building on site, pollution prevention (e.g., for groundwater)	Environmentally sound hazardous waste treatment is required Facilities may not be co-located Geology is suitable for hazardous waste landfill or protection designed such that water resources are not endangered Approval for construction is given Land is brown- or green-field site All hazardous waste and ODS etc from ships treated

Table 4.4. Actions and assumptions on technical assistance to Ministries of Environment and provincial environmental protection authorities

Included actions	Assumptions
It is expected that a comprehensive program is devised and operates until the entry into force of the Hong Kong Convention covering related environmental health and safety and maritime legislation To include a review of the existing arrangements, staffing capacity, and technical training A needs assessment based on the anticipated future size and distribution of the staffing Training programs tailored to the specific needs of the operational units and graded to advanced courses Compliance including enforcement training included for designated officials and judiciary awareness	Training needs assessment identifies all staff requiring training Pilot program is developed and tested No prior knowledge needed—covers all aspects of occupational safety and health, ship recycling hazardous waste, and chemicals management Program replicated at national and regional levels Program refresher at biannual intervals 2010–15 Competency certificates are issued

Table 4.5. Actions and assumptions on drafting new legislation, regulations and guidelines*

Included actions	Assumptions
Comprehensive review of relevant legislation and interfaces with maritime and land-based regulations, including safety and environmental protection Detailed analysis conducted from capacity review to identify new essential components and appropriate linkages with other relevant instruments, such as the Basel Convention, Montreal Protocol, Stockholm Convention, marine pollution legislation, air pollution control, occupational safety and health controls Engagement process with government and relevant ministries to determine scope and extent of legislation needed at the regional and state level Drafting of model legislation Practical survey of guidelines and standards required to fully implement the Hong Kong Convention Establishment of drafting panels with stakeholder engagement and formal consultation procedures A comprehensive program of improvement based on existing legislation is devised and operates until the entry into force of the Hong Kong Convention	Specialized dedicated legal support is provided alongside technical and stakeholder engagement professionals Interministerial coordination is facilitated by the line Ministry and its Departments

* to protect environment and human health and in establishing competent authority under the Hong Kong Convention

Table 4.6. Actions and assumptions on technical capacity building

Included actions	Assumptions
It is expected that a comprehensive program is devised and operates until the entry into force of the Hong Kong Convention A full review of the existing arrangements, staffing capacity, and technical training is carried out A needs assessment is conducted based on the anticipated future size and distribution of staffing Training programs are tailored to the specific needs of the operational units, with refresher, and graded to advanced courses	Specific topic areas are selected according to needs: regulatory standards, hazardous waste recognition and control, occupational health and safety, environmental monitoring, management of ODS, sampling and testing of hazardous materials, regulation– inspection and compliance procedures Training may be three to five days (or longer) depending on scope and level of topic A number of venues would be used according to the specific needs analysis, typically one national and two regional

Country strategy for Bangladesh

Bangladesh has considerable needs in order to attain adequate institutional capacity and provide ground-level enforcement of protection for workers and the environment. Infrastructure improvement needed include improving the capacity and safety of the main roads for transport of all waste and reusable materials generated in the SBRI yards. Significant infrastructure and capacity development in the hazardous waste management sector is also required to achieve proper storage/disposal levels in the long term, leading to compliance with the HKC and other relevant international agreements and guidelines. The implementation of interventions in the area of hazardous waste management and disposal may present opportunities for engaging in public-private partnerships in Bangladesh that could benefit the greater urban zone of Chittagong, the Port of Chittagong, and the ship breaking industry.

The priority actions for Bangladesh in terms of compliance with the Hong Kong Convention and actions to reduce the ship breaking industry's impact on environment and health are provided in Table 4.7.

Table 4.7. Priority actions for Bangladesh

Priority actions	Implementing agent	Cost (million dollars)
<u>Compliance-related:</u>		
Hazardous waste treatment facility provision for environmentally sound management	Ministry of Environment and Forest / Industry jointly	25
Ship Recycling Convention ratification program and regulatory capacity building program; creation of competent authority for SBRI	Several government ministries	3.5
Development of laboratory facilities for environmental (and health) monitoring	MoEF, Min. Labor, Department of Shipping	2
Technical training programs for occupational safety and health, health care, hazardous waste	MoEF, Min. Labor	6
Technical capacity building, several programs	Industry and authorities	2
On-site equipment (weighbridge, impermeable surfaces, drainage, hazardous waste storage)	Industry	0.5–2.0 per plot
<u>Infrastructure:</u>		
Waste reception facilities in ports	Dept Shipping	10
Access roads and infrastructure	Several ministries	up to 20

In the short term, even some simple measures like providing basic personal protective equipment and safety training for workers can improve conditions in the SBRI yards greatly. The timed implementation of measures necessary for compliance in Bangladesh is listed in Table 4.8.

Table 4.8. Necessary measures to achieve HKC compliance in Bangladesh

Time	Necessary measures		Total investment costs ($ million)	Costs per LDT*
1–2 years	• Worker registration and PPE • On-site pollution and safety control equipment • Preparation of various plans (EHS management, ship recycling action plans)		3.5	2–3
3–5 years	• On-site equipment (variable) • Training/capacity	• Health care system • Monitoring Laboratory	20-25	3–4
6–10 years	• Hazardous waste disposal • Thermal treatment facility		25	4

**Including costs of operation and interest payments (10 percent pa) at 1.4 million LDT/year.*

It is found that the above compliance procedures will result in some extra costs for the ship breakers. The assessment shows that an additional $50 million in cost of compliance will translate into additional costs of $9–11/LDT if all these compliance costs are paid by the ship breakers. As these costs are not negligible, they may be applied incrementally over time. The risk that such additional cost would result in relocation is small, as ship breaking is still profitable in Bangladesh under this compliance scenario. This is especially the case if environmental regulations are tightened simultaneously in other South Asian countries.

The assessment presented here does not take into account that Bangladeshi ship breakers typically pay a premium on the purchase price for end-of-life ships compared with ship breakers in Pakistan. Historic data show that the premium is in the region of $10–30/LDT, and these are typically much higher than the compliance costs found in the study. So, over the short term it is the high volatility of the scrap steel price and the premiums paid for ships, rather than compliance costs, that may give rise to non-profitable business cases. (The Bangladesh Ship Breakers' Association has presented a recent case in which costs of scrapping of a tanker exceeded the revenues, leading to a 12 percent loss.) Despite this, there is still a need to promote public-private partnership in environmental management since this will also raise awareness about environmental concerns among the ship breakers. One way may be to impose a separate import tax on scrap ships. The revenue so generated could be funneled back to the industry as matching funds for investments in yards or into facilities, providing common benefits such as training, health care, or waste treatment. However, considering the large employment generation capabilities in an industry that may be susceptible to large cost increases from environmental mitigation, there is also a need for some government financial support. So, the costs of waste reception facilities in ports or the upgrade of the Dhaka-Chittagong road are seen as public investments. Likewise the cost of a hazardous waste facility serving other clients may be partially funded with public resources.

Country strategy for Pakistan

Pakistan must make a range of investments to achieve adequate institutional capacity and provide ground-level enforcement of the protection of workers and the environment in the ship recycling industry. Although situated in a relatively unpopulated area, the infrastructure must be improved in terms of the capacity and safety of the main road to transport all waste and reusable materials generated in SBRI yards. Significant infrastructure and capacity development in the hazardous waste management sector is required to achieve proper storage and disposal levels in the long term, leading to compliance with the HKC and other relevant international agreements and guidelines.

The improvements in the area of hazardous waste management and disposal may present opportunities for engaging in public-private partnerships in Pakistan to the benefit of the local urban area Hub, the greater urban zone of Karachi, the Port of Karachi, and the ship breaking industry. The priority actions for Pakistan for compliance with the HKC and actions to reduce the ship breaking industry's impact on environment and health are shown in Table 4.9.

Table 4.9. Priority actions for Pakistan

Priority actions	Implementing agent	Cost (million dollars)
<u>Compliance-related:</u>		
Hazardous waste treatment facility provision for environmentally sound management	Ministry of Environment /Industry jointly	25
Technical assistance to enhance capacity of Ministry of Environment and provincial environmental protection authorities	Several government ministries, Balochistan and Sindh authorities	3.5
Assistance in drafting new legislation, regulations, and standards to protect environment and human health and in establishing competent authority under HKC	MOE, Min. Labour, Department of Shipping	6.5
Capacity building to develop environmentally sound hazardous waste treatment facilities	Industry, local authorities	3.5
Technical capacity building, several programs	MoE/Dept Shipping/Training Institutes/UNITAR-UNDP	4.0
Housekeeping: weighbridge, impermeable surfaces, drainage, hazardous waste storage	Industry	0.5–2.0 per yard
<u>Infrastructure:</u>		
Waste reception facilities in ports	Dpt Shipping, Marine Pollution Control Centre in Karachi	10
Access roads and infrastructure	Several government ministries	up to 20

In Pakistan, the use of PPE, the mechanization of lifting activities, and other improvements to increase safety are more advanced than in Bangladesh. The existing mechanization and more widespread use of PPE are beneficial, but actions are still needed on a number of impacts. However, the costs for upgrading the capacity of the ship recycling industry and the authorities involved are relatively high on the basis of LDT, since the volumes of ship-for-scrap are much lower in Pakistan than in Bangladesh. The necessary measures for compliance in Pakistan are listed in Table 4.10.

Table 4.10 .Necessary measures to achieve compliance in Pakistan (in dollars)

Time	Necessary measures	Total investment costs (million dollars)	Costs per LDT*
1–2 years	• Worker registration and PPE • On-site pollution and safety control equipment • Preparation of various plans (EHS management, ship recycling, action plans)	2–3	10–20
3–5 years	• On-site equipment • Training/capacity • Health care system	10–15	30–35
rs	• Hazardous waste disposal • Thermal treatment facility	25	40–60

**Including costs of operation and interest payments*

The economic burden of compliance in Pakistan is estimated on the basis of the same assumptions as listed for Bangladesh, except that the level of future ship breaking activity is expected to be considerably lower in Pakistan. The estimated impact on the profit (per LDT) for ship breakers in Pakistan, when all necessary measures are taken, may reach more than $80/LDT. The assessment shows very clearly that the costs of compliance are so high that they may eliminate the basis for ship breaking in Pakistan, if all costs are paid by the ship breakers. The costs of waste reception facilities in ports and the upgradation of the infrastructure in Gadani (e.g water, electricity, sanitation) are foreseen as public investments, but these facilities may accrue revenue from other clients than solely the ship recycling industry.

The investments needed for compliance with the HKC are beyond the financial capacity of the industry in Pakistan. However, the enforcement level is not conducive for command and control strategies, and it is likely that a winning strategy will involve positive partnerships with individual proactive breakers and lower cost incremental improvements to maintain profitability while raising compliance. Thus, international assistance to the Government, the regional authorities and the industry is crucial to the compliance of the ship recycling in Pakistan.

4.2 The risk of industry relocation

Option A: Relocation to "Pollution Haven"

Outside of South Asia, today only China and, to a lesser extent, Turkey are in the global market for larger obsolete vessels. Although the appetite for steel appears to be sizeable in China, prices for ships are still considerably lower there than in Bangladesh or Pakistan and pose no imminent threat to the beaching facilities in these countries. But it can be speculated that improvement in the EHS management of recycling facilities to levels compliant with the HKC and other U.N. conventions on related issues will entail costs that may open a new non-compliant market in ship recycling. This could be in new recycling locations or in one of the countries already engaged in ship recycling if it decides not to become Party to the Convention.

Most flag states are expected to ratify the Hong Kong Convention, and once it has been ratified by two major recycling nations the Convention is expected to enter into force around 2015. At that time ships flying the flags of Parties can only be scrapped in Party states in authorized facilities. Likewise, non-Party states can only scrap ships flying non-Party flags. But since it is relatively easy to change the registration of a vessel, there is a risk that shipowners may choose to re-flag their obsolete vessels before selling them for scrap or simply sell them to a new owner, who may then decide to operate or scrap the vessels under a new flag.

This happens to some extent already today; the 25 leading flag states at the time of de-registration of a vessel (that is, after scrapping or loss at sea) include:[36]

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

These states are not among the top 25 flags where tonnage is registered for ships in service. Yet these seven countries accounted for almost 20 percent of the recycled (or deregistered) tonnage in 2008 and for less than 2 percent of the world's fleet in service that year.

So **is there a risk of relocation of the ship recycling industry to cater to a market accepting ships re-flagged to a non-Party flag and situated in a non-Party state?** Although it cannot be ruled out, it is not considered likely, since a new location competing successfully with South Asian beaching must have at least the following characteristics:

- Strong domestic demand for steel plate and re-bars not readily available from other sources
- A market for equipment and consumables
- Few, if any, enforced regulations on workers' health and safety and environmental pollution
- Wages as low as in Bangladesh or lower

[36] Data from ships demolition databases 2008.

- Natural hydrographical conditions to allow beaching (or similar capital-extensive methodology).

Few states meet these requirements, and the need for a considerable tidal gauge itself is an obstacle for most of Africa or other candidate countries in the Bay of Bengal or the South China Sea (such as Myanmar or Cambodia).

In order to examine the risk of relocation to countries with potential "pollution haven" characteristics, it is relevant to consider the wage differential between them and Bangladesh, and Pakistan. The available information indicates that Cambodia, for instance, and especially Myanmar both have lower wage rates than in Pakistan, whereas Bangladesh might still be able to compete on wages. Hence, the risk of relocation from a wage point of view seems more threatening for Pakistan.

It is also possible that either Bangladesh or Pakistan would attempt to scoop up the non-Party business by not ratifying the HKC, and in both countries this is a scenario being considered by industry actors. Large-profile carriers aside, past experience indicates that it will be difficult to stem the inflow of "re-flagged" end-of-life ships in the short to medium term. Moreover, it is also considered unlikely that, over time, the domestic demand for mild steel in Bangladesh will be able to accommodate a large supply of scrap steel. So, this may ultimately drive down the prices paid for recycled ships. This is a scenario leaving the upgrade of the industry caught between a rock and a hard place. It is therefore clear that investments in improved EHS management are unlikely to happen without financial support. Both lack of regulatory and enforcement options and little investment enthusiasm in industry render the possible improvements reliant on aid assistance. Without aid assistance, the introduction of tougher environmental regulations in Bangladesh and Pakistan could in fact potentially increase the market shares of alternative options for ship recycling.

Option B: Relocation back to Europe or other industrialized region

In theory, **the entire dismantling part of the process could take place in a country that has its own enforceable regulations** regarding both the disposal of hazardous waste and occupational health and safety conditions. The assessment showed that the disadvantage (potential lower revenue and higher costs) of dismantling in western industrial countries is in the region of $155/LDT (Turkey) and $400/LDT (EU, high estimate) compared with Bangladesh and Pakistan. This disadvantage is so large that it seems unlikely that the implementation of compliance will lead to a transfer of activities from South Asia to Europe. So, these may continue to retain their niche markets largely involving government-owned and smaller vessels.

Option C: Pre-cleaning in country of ownership

During the evolution of the Hong Kong Convention, various interests raised the concept of pre-cleaning. If a ship could be cleaned of the hazardous materials originally used or installed during its service life, little risk from such materials would be faced by workers or the environment in the recycling countries. Both recycling countries and international nongovernmental organizations have promoted this idea of pre-cleaning of obsolete ships before they are sent to South Asia. Pre-cleaning activities are envisaged as taking place in the countries where the ships were built or from which they are operated or owned—or indeed any port, repair yard, or similar facility during the last voyage.

If pre-cleaning of the ship takes place in the ownership country and the ship remains in seaworthy condition, it needs to be towed to a recycling country where the actual dismantling and recycling of the marketable materials takes place. The assessment indicates that the costs of pre-cleaning a medium size oil tanker are in the region of $100–200/LDT, while the costs of towing are estimated to be in the region of $65/LDT, assuming U.K. ownership. In addition to this, the cost of "risk of accident by towing" is estimated at $15/LDT.

All together, **the total extra costs of pre-cleaning and towing are in the region of $180–280/LDT**. Therefore, it is considered unlikely that the implementation of the compliance scenario will lead to a decline in activity in South Asian countries due to competition from this option.

4.3 Reducing the risk of hazardous materials before recycling commences

Several pre-cleaning activities that do not involve constructive elements and do not lead to towing can be carried out with relative ease while in a port or on the way. These include cargo space cleaning, emptying of tanks, refrigeration systems, and storage areas, and ventilation of enclosed spaces. This is not a common practice, but undertaking these activities at the last port of call or in the local port as part of a mandatory regime before arriving at the recycling yard will greatly improve safety for workers and simplify the management of hazardous materials. In the process, it may also generate a revenue stream. It is proposed to combine several elements from public and privately run waste management activities that may act with synergy in this particular setting. The detailed design should include:

- MARPOL reception facilities in Ports of Karachi and Chittagong (MARPOL is the international treaty regulating disposal of wastes generated by the normal operation of vessels)
- Establishment of a cargo hold and tank cleaning company
- Development of a hazardous waste and waste storage/disposal facility.

Ships for recycling most often call at Karachi and Chittagong or anchor outside for approvals. This presents an opportunity to perform various pre-demolition activities such as cleaning cargo tanks and emptying bilge tanks, paint and chemical stores, waste oil, and solvents holds. To manage the operationally generated waste of ships calling at the Ports of Karachi and Chittagong, on their final voyage to the beaches, the development of MARPOL reception facilities is proposed. Such facilities may be supplemented with capacity for solid waste and non-operationally generated waste removal, thus forming a broader cost recovery base.

An important part in this exercise would be to develop a Port Waste Management plan. It would serve not only ships being scrapped but also ordinary merchant vessels calling on the ports. The IMO recommends the preparation of such Post Waste Management Plans in order to secure efficient ship waste handling. Besides ship-generated waste, such plans also deal with other wastes brought in by ships, which cannot be classified as "ship-generated" and such cost-efficient ship waste handling can also minimize undue delay for ships.

Other than injury caused by falls, the most serious occupational health hazard in ship recycling arises during work in tanks and enclosed spaces. Fatalities and injuries from explosions of vapors, typically in cargo or fuel tanks, and from asphyxiation after entering into low-oxygen atmospheres in enclosed spaces are common in the industry. Better enforcement of hot work and enclosed space certificates will help, but assistance in cleaning and preparing the areas on the ships for safe work may also be promoted. It is proposed to assist this process through a private sector program with the establishment of a company offering cargo hold and tank cleaning services.

The hazardous waste management (storage, transport, and disposal) facility is a costly requirement to meet. However, it is needed not only for compliance with the HKC but also to meet other obligations such as under the Basel and Stockholm Conventions. The industry sectors of metropolitan areas, the recyclers, and ships calling at the ports may help promote the business case for the development of such facilities. In addition, the inventories of hazardous materials onboard can be carried out while at port to improve the information on the location of hazardous materials on ships. The facilities can also be used for training and testing equipment to facilitate detection of hazardous conditions by the yard staff.

APPENDIX 1: STUDY METHODOLOGY

The study had three interrelated activities:

- Economic and market assessment of the ship breaking and recycling industry (SBRI) in Bangladesh and Pakistan;
- Environmental audits of ships and ship recycling facilities to establish a pollution inventory and a gaps-and-needs assessment for compliance with the Hong Kong Convention (HKC); and
- Consultations with key industry, government, and nongovernmental organization (NGO) stakeholders in the countries and at the global level.

Economic assessment methodology

The economic assessment of the ship breaking industry was carried out in Bangladesh and Pakistan under the prevailing environmental and occupational health regulatory regimes. The estimates used in this analysis are based on reviews, updates, and assessments of previous economic, econometric, and financial studies, as well as field interviews with a large number of stakeholders. The estimates generated in this assessment, however, are subject to some degree of uncertainty. To facilitate cross-country comparison, all profitability calculations are based on the same type of "model" ship—a Panamax oil tanker. The economic and market assessment consisted of:

- review, update, and assessment of previous economic, econometric, and financial analyses of the global trends and demand for ship breaking capacity over the next two decades;
- SBRI market assessment for Pakistan and Bangladesh including the economic, social, and political economy aspects as well as "downstream" demand and industry linkages;
- country-specific and comparative assessments of the profitability and sustainability of the SBRI in Pakistan and Bangladesh; and
- assessment of the financial impacts of different possible levels of implementation of the international regulations in Pakistan and Bangladesh.

Environmental baseline methodology

The environmental baseline was generated through a comprehensive literature review and on-site/on-ship assessments and interviews with ship breakers, shop and yard managers, and other stakeholders. The data on hazardous waste and materials were then measured against other information sources for verification.

Capacity and facility gap analyses were conducted by comparing the likely standards that will be finalized under the new HKC and other relevant guidelines (for example, the guidelines of the Basel Convention and the ILO). The study included:

- reviews and updates of previous assessments of the quantities and types of hazardous materials present in ships scheduled for scrapping and recycling
- institutional gap analysis for Pakistan and Bangladesh looking at existing SBRI regulatory structures and environment, institutional capacities, enforcement issues, and regulatory and compliance gaps vis-à-vis the HKC
- audits of the hazardous materials present in a structured sample of different ships scheduled for breaking and recycling in SAR—the audits were based on the proposed International IMO inventory lists of the potentially hazardous materials present in ships designated for recycling
- Compilation of a structured sample of environmental audits at the ship breaking and recycling sites in Gadani (Pakistan) and Chittagong (Bangladesh); the sample had to be sufficient to establish a baseline and to estimate the costs of remediation and avoidance of future contamination in line with the HKC
- Establishment of a pollution inventory and baseline data on current handling practices, based on the above audits and other relevant data

- Identification and assessment of options (including costing) for hazardous waste handling and disposal to close the gap between existing SBRI practices and what is needed in order to comply with the objectives and targets of international treaties and conventions (particularly the HKC).

Study preparation and stakeholder methodology:

Stakeholder engagement and knowledge transfer were undertaken to ensure that the results and proposals of the study were disseminated widely, that stakeholder perspectives were considered appropriately, and that strong support was received from stakeholder groups. This activity commenced in March 2009 and involved the development and population of a stakeholder matrix detailing the key stakeholders in the three countries. This was subsequently verified through contact with the Consortium's local network of consultants, Government, industry, and NGO representatives in the two countries. An ongoing dialogue was maintained with international organizations that have a vested interest in the ship recycling issue (for example, the IMO, the ILO, and the Basel Convention).

The first phase of consultations with stakeholders took place in April 2009 through targeted meetings in Bangladesh (Dhaka and Chittagong) and Pakistan (Islamabad, Karachi, and Gadani). Contact points were identified and used during the field work, where informal consultations also took place (June–September 2009). A second set of formal consultations was held in November 2009. These consisted of a milestone consultation meeting in Dhaka, Bangladesh, and industry cluster meetings in or near the centers of the SBRI in each country: Chittagong, Bangladesh; Karachi, Pakistan. A list of the stakeholders consulted is available in Appendix 9.

The formal consultative events commenced with presentations of the findings and the draft recommendations of the study, followed by an opportunity for government and industry interventions and a question-and-answer session. The feedback obtained from these consultations was used to inform the preparation of the final report. It was noted that there was wide-ranging support from all stakeholder groups for a regional consultation meeting to be held at the finalization of the study at a "neutral" location.

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APPENDIX 3: THE HONG KONG CONVENTION

A Summary of the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships

1. Introduction

The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (hereafter referred to as "the Convention") was adopted at a Diplomatic Conference held in Hong Kong, China, 11–15 May 2009, under the auspices of the IMO. The Convention deals with many matters that are generally described here but are not covered in detail. The main context for this note is the management of hazardous materials within the ship recycling industry. The note describes the main features of the Convention, providing a summary of the whole Convention and its general implications for states, ship owners, and ship recyclers along with key issues including entry-into-force conditions. The challenges facing one of the current ship recycling states (Bangladesh) are assessed, indicating some of the pressures and the gaps that may need to be filled to bring about ratification and implementation of the Convention. Some possible next steps are outlined along with the approach that might be taken by other IMO member states. The latter has particular significance, bearing in mind the interconnectedness of the Convention's entry-into-force requirements.

2. Main features of the Convention

2.1 The Convention text

This section outlines the main features of the Convention as set down in the text adopted at the Diplomatic Conference held in Hong Kong on 15 May 2009. The general structure of the Convention is that of enabling Articles containing requirements appropriate to ship recycling, together with standard mechanisms for the operation of international agreements, such as entry-into-force conditions. Detailed requirements are contained in the text of regulations that are in an Annex. The Annex itself is designated as an integral part of the Convention, meaning that the requirements of the Annex have the same force as those of the Articles to the Convention.

2.2 The Articles

The Articles and their obligations are now fixed and unalterable since adoption, except in accordance with the Convention's amendment procedure (Article 18). Operation of this would first require entry into force. Any changes that might then be considered would first be subject to discussion through the IMO negotiating processes, usually by means of the Marine Environment Protection Committee (MEPC).

The Convention has 21 Articles setting out the main obligations. These include: definitions and scope (applying to ships of 500 gross tons and over operating internationally, excluding government-owned ships) (Article 3); Ship Recycling Facilities must be authorized in accordance with the Convention's regulations (Article 6); ships are subject to inspection in ports (Article 8). On enforcement provisions, detection of violations of the Convention are set out in Article 9, and Article 10 requires violations of the Convention to be prohibited by national laws that provide sanctions. On communication, Parties to the Convention must report certain information to the IMO, such as a list of authorized ship recycling facilities, Competent Authority contact details, recognized organizations acting on behalf of the Party (e.g., for surveys), a list of ships with an International Ready for Recycling Certificate, a list of ships recycled annually, and any violations and actions taken against ship recycling facilities.

Articles 14 to 16 deal with dispute settlement, relationship with other international laws, ratification, etc. Entry into force requirements are in Article 17 and are considered further below.

2.3 The Annex – Regulations

The essential requirements of the Convention are contained herein four Chapters, with detailed conditions to be observed and signposts to relevant guidance, the latter yet to be developed by the IMO. Ultimately these regulations may be adapted over time, as experience indicates, through the IMO's negotiation mechanism. This process would require the Convention to have entered into force and some experience to have been gained in practice of the operation of the Convention.

Chapter 1 - General Provisions: Regulations 1 to 3 provide further definitions and scope. In particular, Regulation 3 refers to the "applicable standards" found in the material developed by the ILO and the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal, to be taken into account by Parties (i.e., the states that have ratified the Convention and are bound by its provisions) when taking measures to implement the requirements of the Annex.

Chapter 2 – Requirements for Ships: Regulation 5 provides for new and existing ships to possess an Inventory of Hazardous Materials, materials that the ship contains in its structure and equipment, to be kept updated. Just before recycling, the inventory is to be supplemented with information about stores and operational wastes. Regulation 9 requires a Ship Recycling Plan to be prepared by the ship recycling facility and be "explicitly or tacitly approved by the Competent Authority authorizing the ship recycling facility," the chosen approval option (tacit or explicit) being decided at its ratification stage by the state concerned. The exact nature of the written notification procedures to other authorities and the ship owner depend on the tacit/explicit option selected. Regulations 10 to 14 deal with surveys and certification of ships by the Administration (Flag State) under the Convention.

Chapter 3 - Requirements for Ship Recycling Facilities: Regulations 15 to 23 require a Party to the Convention to establish legislation, regulations, and standards that are necessary to ensure that ship recycling facilities are designed, constructed, and operated in a safe and environmentally sound manner in accordance with Convention regulations. An authorization process is required with inspection, monitoring and enforcement provisions, including powers of entry and sampling. Ship recycling facilities shall establish management systems, procedures, and techniques that do not pose risks to the workers concerned or to neighbours and that, to the extent practicable, eliminate adverse effects on the environment, taking into account guidelines developed by the IMO.

Chapter 4 – Reporting Requirements: Regulations 24 and 25 establish notification procedures concerning the intention to recycle a ship so that final surveys may be arranged and specify the information to be given to the ship recycling facility's competent authority by the facility. A Statement of Completion is issued by the facility to the competent authority when the ship has been recycled.

2.4 The Annex – Appendices

There are seven appendices that, among other things, establish the hazardous materials list and set out the forms of documentation and certificates to be used. These appendices do not have a significant role in setting standards but do provide necessary items such as a common information base and a consistent format for documentation that will assist the smooth operation of the Convention's procedures. The materials to be included in the hazardous materials list in Appendix 2 are significant, as these at least have to be included on the Inventory. Additions to this list will be updated via the MEPC.

2.5 Guidelines "to be taken into account"

These are currently being developed through the IMO's MEPC, comprising representatives of all IMO member states. The Guidelines for Development of the Inventory of Hazardous Materials have already been adopted (2009), and the recycling facility guidelines are currently being developed, both of which are seen to be priorities for the operation of the Convention. These guidelines carry more weight than the existing ILO/IMO/Basel Convention Guidelines, as they are empowered by the Convention and will have been specifically developed to deliver operational details in accordance with the Convention's Regulations. These guidelines are most likely to affect the key issues of standards on ships and at ship recycling facilities. In this context, Regulation 3, which requires existing ILO and Basel Convention Guidelines to be taken into account during the development of the IMO Guidelines, is most likely to have an impact on standard setting for environmental protection and on health and safety requirements.

The Guidelines to be developed currently cover:

- Inventory of Hazardous Materials
- Survey and Certification
- Inspection of Ships
- Authorization of Ship Recycling Facilities
- Safe and Environmentally Sound Ship Recycling
- The Ship Recycling Plan

Countries aiming to implement the Convention will want to be well informed on the content of these guidelines as they are drafted and adopted, to inform the development of their own legislative proposals. For example, preparation of the Ship Recycling Plan and the Ship Recycling Facility Management Plan will draw extensively on the guidelines, and how these are to be taken into account in implementing legislation will need to be carefully considered.

3. Key Issues Arising from the Convention's Adoption

3.1 Need for New Legislation at State Level

From the comprehensive nature of the Convention, its wide scope, and its specificity, it is almost inevitable that all states wishing to become Party to the Convention will need to enact new Acts and/or Regulations in order to establish the means by which compliance with the provisions of the Convention can be achieved. It is likely that only those states with broad enabling powers for shipping and environmental protection on land will not need to pass new Acts, and all will need to adapt or develop new regulations and put in place the mechanisms and structures for their administration and enforcement.

The rest of this section briefly outlines some of the Convention's provisions that are seen as key for its implementation and their impact on standards of ship recycling in particular.

3.2 Entry into Force

The conditions for entry into force of the Convention have to be met before the Convention can be made effective globally. The conditions are that:

- Fifteen states have ratified it
- Merchant fleets of those states constitute not less than 40 percent of the gross tonnage of the world's merchant shipping
- The recycling volume of those states during the preceding 10 years is not less than 3 percent of the gross merchant shipping tonnage of those states.

The Convention then enters into force 24 months after these conditions are met. There is no set timescale over which this will occur; it will be a natural consequence of events as states deposit their instruments of ratification until the target is met.

3.3 Standards

In this context, the actual standards under which ship recycling is to be carried out are not necessarily found within the Convention. These, as described above, are a matter for more detailed documents that are under preparation. The Convention in this sense sets the direction. It determines the criteria and scope for ship recycling standards (as well as other matters) so that what is to be covered in terms of protection of the environment and occupational health and safety is established. The detail of how this is to be applied will be set out in the guidance documents developed according to the Regulations of the Annex to the Convention. Much may therefore be determined by the outcome of the negotiations on the drafts of the guidance documents currently before the MEPC Working Group for its consideration.

3.4 Reporting

Reporting is the means of establishing how compliance with the Convention is progressing. Reporting is not restricted to those elements of the Convention specifically labelled as such, but here refers to all the communication of data and information that provides a means of monitoring the operation of the Convention and its effectiveness, especially where the information is transmitted to one of the main bodies involved such as the IMO rather than simply between Parties for a particular ship recycling transaction.

The obligations of the Convention are in this respect spread across a number of its Articles and Regulations in the Annex. These include Article 9 on Detection of Violations (see Articles 9.2, 9.3, 9.4) and similarly for Article 10 on Violations. Article 12, Communication of Information, specifically sets out a range of information to be reported to the International Maritime Organization, including the ship recycling facilities authorized by a Party, contact details of competent authorities, recognized organizations empowered to act on behalf of a Party, an annual list of ships to which an International Ready for Recycling Certificate has been issued, an annual list of ships recycled, and violations.

3.5 Safety

Occupational health and safety at ship recycling facilities is covered in some detail in the Regulations in the Annex in Chapter 3. Guidelines will be developed to supplement the Regulations intended to be consistent with international standards, especially those developed through the ILO as expressed by the International Labour Office during the course of the negotiations on the text of the Convention. Prevention of adverse effects to human health and the environment, emergency preparedness and response, worker safety and training, and the reporting of incidents, accidents, occupational diseases, and chronic effects are all covered by the Regulations.

4. Transitional measures to work toward entry into force of the Convention

4.1 Possible transitional actions by states.

The Diplomatic Conference adopting the Convention passed a number of Resolutions, not part of the text of the Convention but complementary to it and its future implementation pathway. The Diplomatic Conference envisaged that a number of states may request technical assistance to give full and complete effect to the provisions of the Convention.

4.2 Resolutions of the Diplomatic Conference

Resolution 3 of the Diplomatic Conference specifically addresses the provision of technical assistance and cooperation between states and with the IMO as well as other international development organizations and agencies. While the context for this is based on Article 13 for Parties to the Convention, the Resolution addresses member states of the IMO and so allows the opportunity for transitional assistance and cooperation prior to either a state becoming a Party to the Convention or the Convention’s entry into force.

Resolution 3 promotes technical cooperation and assistance between member states of the IMO through:

- assessment of implications of ratifying the Convention;
- development of national legislation and institutional arrangements to give effect to the Convention;
- introduction of environmentally sound management for hazardous materials and wastes from ship recycling;
- training for implementation and enforcement of the Convention; and
- co-operation between shipbuilding and ship recycling countries on research.

Resolution 5 also invites IMO member states and industry to apply the technical standards of the Convention on a voluntary basis prior to its entry into force.

APPENDIX 4: ECONOMIC ESTIMATES

Table A4.1 Summary Table (in dollars based on 14,800 LDT Panamax vessel)

Category	Element	Bangladesh	Pakistan
Revenue	Steel	4,771,500	4,992,800
	Other recyclable items	842,000	512,700
	Total revenue	5,613,600	5,505,500
Costs	Purchase of ship	3,848,000	3,848,000
	Investment costs	21,900	18,300
	Financial costs	147,900	265,700
	Labor costs	92,700	233,400
	Consumables	302,200	230,000
	Taxes, tariffs and duties	263,000	693,600
	Rents, levy and permits	2,700	500
	Other costs	13,800	51,300
	Total costs	4,692,200	5,340,800
Profit	Total	921,400	164,600
	$/LDT	62	11
	Total, local currency	62,231,800	13,307,700
	Rs./LDT	4,200	900

Table A4.2 BANGLADESH (Overall Financial Analysis)

	Main element	Sub element	Unit	Bangladesh
Revenue	Revenue from steel		$/vessel	4,771,543
	Other recyclable items		$/vessel	842,037
	Total revenue		$/vessel	**5,613,580**
Costs	Purchase of ship		$/vessel	3,848,000
	Investment costs		$/vessel	21,913
	Financial costs		$/vessel	147,912
	Labor costs		$/vessel	92,653
	Consumables		$/vessel	302,207
	Taxes, tariffs and duties		$/vessel	262,955
	Rent, levies and duties		$/vessel	2,713
	Other costs		$/vessel	13,820
	Extra costs, tougher environmental regulation	a. Purchasing and construction costs for new equipment and infrastructure	$/vessel	0
		b. Manpower costs for new and more time-consuming work routines	$/vessel	0
		c. Hazardous waste disposal costs	$/vessel	0
		Total extra costs	$/vessel	0
	Total costs		**$/vessel**	**4,692,173**
Profit			**$/vessel**	**921,407**
			$/LDT	**62**
			Local currency/vessel	**62,231,803**
			Local currency/LDT	**4,205**

Table A4.3 Bangladesh (Revenues)

Price, scrap steel	Unit	
Main analysis	Re-rollable steel, local currency/ton	26500
	Melting scrap, local currency/ton	21500
	Share of re-rollable steel	85%
	Share of melting scrap	15%
	Average price, local currency/ton	**25,750**
	Average price, $/ton	**381**

Table A4.4 Bangladesh (Revenues)

LDT per ship		
Size of ship	80,000	DWT
Conversion rate	0.185	LDT/DWT
LDT	14,800	

Table A4.5 Bangladesh (Revenues)

	Recovery (%)	Quantity (Tons)	Rs. Unit Selling Price	Revenue	$
Re-rolling Scrap	70	10,360	26500	274,540,000	4,064,850
Melting Scrap	15	2,220	21500	47,730,000	706,692
Other elements	8	1,184	15%	56,871,176	842,037
Weight Loss	7	1,036			
Total	100	14,800		379,141,176	5,613,580

Table A4.6 Bangladesh (Cost - Purchase Price of Ship)

Main analysis	$/LDT	260

Table A4.7 Bangladesh (Investment Cost)

Investment costs for equipment and civil works		
In local currency	Total	30,000,000
Depreciation rate		10%
Residual value		20%
Annual costs		2,400,000
Costs per panamax tanker		1,480,000
	In $	21,913

Table A4.8 Bangladesh (Financial Cost)

Per ship, $	147,912

Table A4.9 Bangladesh (Labour Cost)

See report for sources/calculation assumptions			
		In Tk	In $
Fixed labor	Per ship	1,985,667	29,400
Hired labor	Total wage bill	4,272,087	63,253
Total	**Per ship**	**6,257,754**	**92,653**

Table A4.10 Bangladesh (Consumables)

Consumables		Unit
Oxygen tk/m3	23	Tk
LPG tk/kg	90	Tk
Use of oxygen	25	m3/ton steel generated
Use of LPG	10	kg/ton steel generated
Costs for other consumables	10%	extra
Total costs	1,623	Tk/ton
Total costs per ship in Tk	20,411,050	Tk
Total costs per ship in $	302,207	$

Table A4.11 Bangladesh (Taxes, Tariffs and Duties)

Tk/ton	$/ton	$/ship
1,200	18	262,955

Table A4.12 Bangladesh (Rents, Levies and Duties)

Rents, levies and duties	Tk	$	tk/ship	$/ship
Rents pr ship				1,233
Port charges			100,000	1,481

Table A4.13 Bangladesh (Other Costs)

Other costs	tk/ship	$/ship
Inspections for ‘Gas free certification’	32,000	474
Beaching costs	110,000	1,629
Clearing and forwarding costs	35,000	518
Tug charges	120,000	1,777
Sub Total	297,000	4,397
BSBA fees	44,400	657
Local committee donation	592,000	8,765
Total	933,400	13,820

Table A4.14 Bangladesh (Annual Dismantling Activity)

App. 2 ships of the average size 10-12,000 tons	
Assumed in main analysis, LDT	24000
Ships pr year	1.62

Table A4.15 PAKISTAN (Overall Financial Analysis)

	Main element	Sub element	Unit	Pakistan
Revenue	Revenue from steel		$/vessel	4,992,780
	Other recyclable items		$/vessel	512,681
	Total revenue		$/vessel	5,505,461
Costs	Purchase of ship		$/vessel	3,848,000
	Investment costs		$/vessel	18,310
	Financial costs		$/vessel	265,670
	Labor costs		$/vessel	233,398
	Consumables		$/vessel	229,955
	Taxes, tariffs and duties		$/vessel	693,613
	Rent, levies and duties		$/vessel	531
	Other costs		$/vessel	51,344
	Extra costs, tougher environmental regulation	a. Purchasing and construction costs for new equipment and infrastructure	$/vessel	0
		b. Manpower costs for new and more time-consuming work routines	$/vessel	0
		c. Hazardous waste disposal costs	$/vessel	0
		Total extra costs	$/vessel	0
	Total costs		$/vessel	5,340,822
Profit			**$/vessel**	**164,639**
			$/LDT	**11**
			Local currency/vessel	**13,307,749**
			Local currency/LDT	**899**

Table A4.16 Pakistan (Revenues)

Steel LDT per ship		
Size of ship	80,000	DWT
Conversion rate	0.185	LDT/DWT
LDT	14,800	

Table A4.17 Pakistan (Revenues)

	Recovery (%)	% of steel output	Quantity (Tons)	Tk. Unit Selling Price	Revenue	$
Steel	85					
- normal steel		99%	12,454	32000	398,534,400	4,930,526
- prime steel		1%	126	40000	5,032,000	62,254
Other elements	8		1,184	35000	41,440,000	512,681
Weight Loss	7		1,036			
Total	100		14,800		445,006,400	5,505,461

Table A4.18 Pakistan (Cost)

Purchase price of ship	Unit	
Main analysis	$/LDT	260

Table A4.19 Pakistan (Investment Costs for Equipment and Civil Works)

In local currency (Total)	30,000,000
Depreciation rate	10%
Residual value	20%
Annual costs	2,400,000
Costs per panamax tanker ($)	1,480,000
	18,310

Table A4.20 Pakistan (Financial Costs)

Bank interest per ship	265,670

Table A4.21 Pakistan (Labour Cost)

See report for sources/calculation assumptions			
		In Rs	In $
Total	Per ship	18,865,556	233,398

Table A4.22 Pakistan (Taxes, Tariffs and Duties)

Taxes		**Tk per ship**	**$ per ship**
GST (Rs per MT)	3,550	52,540,000	650,006.19
BDA Charges (Rs per MT)	28	414,400	5,126.81
Withholding Tax (% of Value)	1%	3,110,338	38,480.00
Total		**56,064,738**	**693,613.00**

Table A4.23 Pakistan (Other Costs)

Transportation	
Cost for first 15 tonnes (Rs)	6,000
Additional Cost per tonnage (Rs)	225
Average Carrying Capacity of Truck in ton	40
Weight to be transported to Shershah (ton)	13,764
No of Trucks required	344
Cost per truck (Rs)	11,625
Total Transportation Costs (Rs)	4,000,163
- in$	49,489
Beaching costs between	25,000-150,000 Rs
Assumed	150,000
- in $	1,856

Table A4.24 Pakistan (Annual dismantling activity)

App. 2 ships of the average size 10-12,000 tons	
Assumed in main analysis, LDT	24000
Ships pr year	1.62

Table A4.25 Exchange Rates

Bangladesh	100 taka= X USD	1.48
	1 taka= X USD	0.01
	1 USD= X taka	67.54
Pakistan	100 Rs=X USD	1.24
	1 Rs= X USD	0.01
	1 USD= X Rs	80.83

APPENDIX 5: SHIP AUDITS

TABLE A5.1 MERCHANT FLEET (calculations are on the basis of declared hazardous materials from the following number and types of ships: one container ship, four ro-ros, five oil tankers, three chemical tankers, and one non-cargo ship)

Merchant Fleet - Mean Total

	Hazardous Material	Unit	Material Total	1000 GT total	Material/ million GT	Range of Ship size [GT]	Range of material	Range of material/ million GT	No. observations	Compiled from entry no.
1	Asbestos	ton	335	659	509	960 - 156,815	0.05 - 150	0.76 - 3666.94	13/14	
2	PCB									
2.1	PCB liquids (transformers, etc)	kg	0.00	452	0.00	960 - 156,815	No range	No range	8/14	
2.2	PCBs solids (capacitors, ballasts, etc)	kg	0.35	208	1.66	51,071 - 156,815	0.300 - 0.045	0.29 - 5.87	2/14	
3	Hydraulic oil	ton	18	158	113	960 - 156,815	2.22 - 16.0	99.86 - 2312.5	2/14	
4	ODS									
4.1	ODS liquids (CFC, Halons, etc)	ton	2.52	350	7	960 - 156,815	0.16 - 0.91	5.29 - 167.08	6/14	
4.2	ODS solids (e.g PU)	ton	303	173	1753	35,431 - 51,071	0.03 - 300	0.75 - 8467.06	4/14	
5	Paints									
5.1	Paints no info	ton	65	157	415	no range	no range	no range	1/14	
5.2	Paints cont. TBT	ton	4	305	14	960 - 156,815	0.00 - 2.98	7.65 - 66.25	5/14	
5.3	Paints cont. PCB	ton	No information available							
5.4	Paints cont. Metals	ton	No information available							
6	Heavy metals									
6.2	Cadmium	ton	0.30	158	1.90	960 - 156,815	0.0002 - 0.3	0.21 - 1.91	2/14	
6.4	Mercury	kg	16.23	371	43.75	960 - 156,815	0 - 5	0 - 146.06	6/14	
7	Radioactive substances	kg	No information available							
8	Waste liquids organic	m3	1923	340	5654	960 - 156,815	0.056-1820	1.25 - 11,606.05	7/28	8.1-8.2

Merchant Fleet - Mean Total - cont'd

	Hazardous Material	Unit	Material Total	1000 GT total	Material/ million GT	Range of Ship size [GT]	Range of material	Range of material/ million GT	No. observations	Compiled from entry no.
9	Reusable liquids organic (HFO, diesel)	ton	1550	483	3208	960 - 156,815	5.21 - 567	907.18 - 12,802.19	9/14	
10	Misc									
10.1	Ballast Water (C-34)	ton	2518	42	59485	No range	no range	no range	1/14	
10.2	sewage (C-35)	m3	28	42	661	No range	no range	no range	1/14	
10.3	Garbage (C-42)	ton	0.10	44	2.3	No range	no range	no range	1/14	
10.4	Incinerator ash (C-41)	ton	0.05	26	1.9	No range	no range	no range	1/14	
10.5	Oily rags (C-45)	ton	0.22	70	3.1	35,431 - 44,289	0.02 - 0.2	0.0006 - 0.00452	2/14	10.5
10.7	Batteries nickel/ cadmium	units	7	42	165	No range	no range	no range	1/14	
11	Waste liquids inorganic (acids)	m3	0.04	157	0.28	No range	No range	No range	1/14	
12	Reusable liquids organic (other)	m3	151	246	615	960 - 156,815	0.24 - 86.0	250 - 23,177.08	6/42	12.1, 12.2, 12.4
13	Misc									
13.4	Batteries lead (C46)	ton	0.35	157	2.23	156,815	no range	no range	1/14	

TABLE A5.2 NAVAL FLEET (calculations are on the basis of declared hazardous materials from the following types and numbers of naval ships: two aircraft carriers, four supply/cargo, two misc., one radar, and four tankers)

Naval Fleet - Mean Total

	Hazardous Material	Unit	Material Total	1000 LDT Total	Material / million LDT	Range of ship size [LDT]	Range of material	Range of material/ million LDT	No. observations	Compiled from entry no.
1	Asbestos	ton	2655	154	17222	4,700 - 26,705	76 - 771	7,088 - 26,417	15/15	
2	PCB									
2.1	PCB liquids (transformers, etc)	ton	No information available							
2.2	PCBs solids (capacitors, ballasts, etc)	ton	823	149	5508	5,174 - 26,705	13.7 - 286.0	2,574 -23,833	14/15	
3	Hydraulic oils	ton	49	31	1560	4,700 - 26,705		749 - 6,170	2/15	
4	ODS									
4.1	ODS liquids (CFC, Halons, etc)	ton	No information available							
4.2	ODS solids (e.g PU)	ton	No information available							
5	Paints									
5.1	Paints no info	ton	183	5	38936	No range	No range	No range	1/15	
5.2	Paints cont. TBT	ton	No information available							
5.3	Paints cont. PCB	ton	No information available							
5.4	Paints cont. Metals	ton	120	5	25532	No range	No range	No range	1/15	
6	heavy metals									
6.1	Lead	ton	0.16	5	34	No range	No range	No range	1/15	
6.4	Mercury	ton	2.00	27	75	No range	No range	No range	1/15	
7	Radioactive substances	kg	No information available							
8	Waste liquids organic	m3	248	132	1880	4,700 - 14,170	0.20 - 237.10	43 - 22,111	15/30	8.1, 8.2
9	Reusable liquids organic (HFO, diesel)	ton	3472	154	22522	4,700 - 26,705	7.0 - 813.5	75 - 157,228	15/15	

Naval Fleet - Mean Total – cont'd

	Hazardous Material	Unit	Material Total	1000 LDT Total	Material / million LDT	Range of ship size [LDT]	Range of material	Range of material/ million LDT	No. observations	Compiled from entry no.

10	Misc.									
10.1	Ballast Water (C-34)	ton	8667	31	275975	4,700 - 26,705	4,316 - 4,351	162,928 - 918,298	2/15	
10.2	sewage (C-35)	m3	No information available							
10.3	Garbage (C-42)	ton	No information available							
10.4	Incinerator ash (C-41)	ton	No information available							
10.5	Oily rags (C-45)	ton	No information available							
10.7	Batteries nickel/ cadmium	unit s	No information available							
11	Waste liquids inorganic (acids)	m3	2.00	4.70	426	No range	No range	No range	1/15	
12	Reusable liquids organic (other)	m3	192	132	1451	4,700 - 14,170	0.009 - 24.49	2 - 7,748	15/30	12.2, 12.3
13	Misc.									
13.4	Batteries lead (C46)	kg	160	5	34043	No range	No range	No range	1/15	

CONVERSIONS

Paint: In the merchant vessel category one set of paint data is given in volume. This is converted to mass with a ration 1:1 (1000L = 1 ton).

GT/LDT: Conversion factors from LDT to GT on tankers and bulkers are based on figures from the corresponding datasets presented by Mikelis (2007). The lightship weight, given in long tons, is converted to metric ton with a factor 1.017 (Dear and Kemp 2006).

The conversion factor used from LDT to GT on vessels other than tankers and bulkers in the merchant fleet is derived from the abovementioned data but corrected by a factor of 0.72 to correspond to actual scrapped volumes from the total fleet. The correction factor is based on a comparison of historic GT volume scrapped (SAJ 2009) and LDT figures on volume scrapped (Cotzias 2009) for all ship types.

GT/DWT: Conversion from DWT to GT is based on the vessels size using data from Mikelis (2007).

Hydraulic oil, HFO, and diesel: Some data were given in m^3, other data were in kg. Converting factors were chosen on the basis of typical mean values:
Hydraulic oil: 0.87 (Esso, 2003)
HFO: 980 kg/m^3 (Concawe, 1998)
Fuel oil/diesel (distillates) 900 kg/m^3 (www.en.wikipedia.org/wiki/Fuel_oil)

Units: The amounts of some items in base data are declared as *units* and not *kg*, m^3, etc. These are not included in mass calculations due to incomplete information.

Phase out assumptions for accumulation 2010 to 2030

ODS liquids phaseout correction: Levels of potential imports of liquid ODS are corrected annually with –6 percent from 2004 to 2019. Hereafter, the amount of ODS levels out and stabilizes at a total of 2.5 percent. This allowance represents the amount of HCFC not phased out at this point in time.

ODS solids phaseout: The majority of the ODS solids declared are polyurethane insulation foam (PU). The level of potential import is corrected with –5 percent starting from 2017.

PCB phaseout correction: Levels of potential imports of PCBs are decreased 7 percent annually from 2007 to 2020, and thereafter –1 percent and nil from 2029. In 2029, it will be more than 50 years since PCBs were banned and is expected that they will only occur in extremely rare cases (very old vessels and possibly as secondary contamination).

Asbestos correction: The level of potential imports of asbestos has been corrected with –2 percent from 2023.

Profiles: Only profiles on asbestos, PCBs, and ODS are made, as none of the other materials are currently phased out and therefore follow the world scrapping tonnage curve. It is not at this point possible to forecast the levels and phaseout profile of other restricted materials such as mercury, selected brominated flame retardants, or chlorinated paraffins.

Backlog: The volume backlog of scrapped vessels resulting from the drop in recycling in the period 2005–08 is calculated on the basis of the mean volume of scrapped vessels in the period 1992–2004. Figures are found in *Shipbuilding Statistics 2009*, published by Shipbuilders Association of Japan (SAJ 2009). The expected volume scrapped/year is calculated to 12,445 million GT. The backlog is the build up through the four years (2005–08) amounting to 28,332 million GT waiting to be scrapped in all.

Fraction of world scrapping: The South Asian fraction of backlog is assigned to Bangladesh, India, and Pakistan. This is done on the basis of their respective fraction of the world scrapping volume, which is derived from *Shipbuilding Statistics 2009* (SAJ, 2009).

APPENDIX 6: SITE ASSESSMENTS/AUDITS

Approach: From the literature it was identified that, of the studies carried out at ship recycling yards, more reports were available on the marine environment around ship recycling activities and fewer on the land condition. There are many studies and programs on the Bay of Bengal, for example. Gathering data on the ground condition at yards was therefore of more interest within the limits of this study. A sampling methodology was devised based on standard soil investigation techniques that would provide a basis for comparison and future work, as described below.

Yard selection and access. Access to these sites to take samples was arranged locally. The yards that granted access may or may not be considered to be representative of all other yards. Visual inspection of adjacent yards showed no significant differences in vessels being dismantled or working practices that would suggest the yards visited were not representative. In total, five yards were sampled. Three were sampled at Chittagong in Bangladesh and two at Gadani in Pakistan.

Field sampling method - all sites

Sampling Protocol

1. A sketch plan of the yard was made with the assistance of the site supervisors. The yard dimensions and location of the key fixed equipment and infrastructure were recorded. Particular locations where specific activities were carried out (e.g., cutting) were also marked on the sketch plan. Any information about possible hotspot locations was also noted.

2. A "W" grid pattern was marked on a copy of the yard sketch plan, within the boundaries of the site.

3. Five (5) numbered sampling points were marked along the length of the "W" for later cross reference to the sample containers. The points were evenly distributed covering the whole length of the "W."

4. "Hot spot" locations were marked on the plan (e.g., as HS1 and HS2 to distinguish them from the "W" samples), where these could be identified (a maximum of two).

5. At each sample location within an approximate 2 meter radius, three sample points were selected. At each point the surface soil was scraped to a depth of approximately 20mm and a measured scoop of approximately 750mm of soil was removed down to some 150mm and placed in a bulk sample container.

6. The material in the bulk sample container was transferred to a mixing tray.

7. The bulk sample was thoroughly mixed by cutting and turning over five times. Large objects >10mm were removed. (Note that objects were not removed from hotspots where specific material may be the subject of further analysis)

8. The bulk sample was leveled in the tray to a depth of some 25mm, and this was subdivided into four sections.

9. An aliquot of soil was removed from each of the four sections randomly, providing a weighed amount of some 200gm from each section.

10. These aliquots were transferred to a 500ml sample jar and sealed, each numbered according to the site location plan. Jars were given unique identifiers, including date and number but not name. Records were kept to correlate each sample with its original location on the sketch plan for each yard.

Analytical Method

The samples were transferred to reputable laboratories for analysis. In selecting the laboratories, it became clear that while standard methods for heavy metal analyses are commonly used, more sophisticated techniques for PCBs and TBT restrict choice and availability within time and price constraints. It was necessary to analyze the sample from the yards in Chittagong in India. A suitable laboratory was found in Pakistan for the Gadani samples.

Results: Bangladesh

Table A6.1 Soil Metal, PCB, Asbestos and Oil concentrations in 3 Ship Recycling Yards in Chittagong, August 2009 (Results in mg/kg or as stated)

Yard 1	**Soil 1**	**Soil 2**	**Soil 3**	**Soil 4**	**Soil 5**	**Hot Spot 1**	**Hot Spot 2**
Lead (Pb)	248.0	898.0	77.0	450.0	229.0	313.0	128.0
Cadmum (Cd)	2.2	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Chromium (Cr)	157.0	180.0	66.0	138.0	123.0	175.0	164.0
Mercury (Hg)	0.1	0.2	0.05	0.10	0.2	n.d.	0.1
Asbestos (fibres/g)	4	2	400	3	14	2	18
PCB	n.d.	n.d.	n.d.	n.d.	n.d.		
Oil & grease	-	-	-	-	-	4.43%	0.32%
Yard 2	**Soil 1**	**Soil 2**	**Soil 3**	**Soil 4**	**Soil 5**	**Hot Spot 1**	**Hot Spot 2**
Lead (Pb)	206.0	217.0	334.0	138.0	262.0	319.0	-
Cadmum (Cd)	0.6	n.d.	n.d.	n.d.	n.d.	1.0	-
Chromium (Cr)	169.0	160.0	152.0	134.0	149.0	137.0	-
Mercury (Hg)	0.2	0.3	0.3	n.d.	0.2	0.1	-
Asbestos (fibres/g)	3	3	6	16	11	5	-
PCB	n.d.	n.d.	n.d.	n.d.	n.d.	-	-
Oil & Grease	-	-	-	-	-	0.49%	
Yard 3	**Soil 1**	**Soil 2**	**Soil 3**	**Soil 4**	**Soil 5**	**Hot Spot 1**	**Hot Spot 2**
Lead (Pb)	212.0	151.0	274.0	174.0	154.0	-	-
Cadmum (Cd)	n.d.	n.d.	n.d.	n.d.	n.d.	-	-
Chromium (Cr)	143.0	192.0	178.0	238.0	180.0	-	-
Mercury (Hg)	0.3	BDL	n.d.	0.2	0.1	-	-
Asbestos (fibres/g)	6	5	3	7	10	-	-
PCB	-	-	-	-	-	-	-

Table A6.2

Techniques used for analysis	
Metals	AAS
PCBs	GC-MS
Oil and grease	Gravimetric
Limit of detection (LOD)	
Analyte	**LOD(mg/kg)**
Cadmium	0.5
Chromium	2.0
Mercury	0.05
PCBs	0.01
Limit of detection for PCBs in paper is 0.1 mg/kg	

Results: Gadani, Pakistan

Table A6.3 Soil Sample from Shipyard # 1

S.No	Parameters	Unit	Method	Y1-1	Y1-2	Y1-3	Y1-4	Y1-5
1	Asbestos		X-ray Diffraction	N.D	N.D	N.D	N.D	N.D
2	Total Oil	mg/kg	Solvent extraction	2250.0	659	485	2952	2118
3	Cadmium	mg/kg	AAS	BDL	BDL	BDL	BDL	BDL
4	Chromium	mg/kg	AAS	14.71	10.94	22.12	19.65	21.19
5	Lead	mg/kg	AAS	102.26	122.75	106.96	122.38	27.62
6	Mercury	mg/kg	USEPA 3052	0.137	0.134	0.105	0.158	0.121
7	PCB –15	ppb	GCP	6.45	6.18	4.43	11.52	0.01
8	PCB – 101	ppb	GCP	0.35	0.00	0.01	0.48	0.67
9	PCB - 151	ppb	GCP	0.41	0.00	0.04	0.00	0.14
10	PCB - 118	ppb	GCP	0.26	0.11	0.00	0.03	0.16
11	PCB - 153	ppb	GCP	0.08	0.00	0.22	NO	0.73
12	PCB - 141	ppb	GCP	0.01	0.52	NO	NO	0.15
13	PCB - 138	ppb	GCP	0.99	0.00	0.22	NO	2.75
14	PCB - 187	ppb	GCP	2.99	0.24	0.01	NO	0.06
15	PCB - 180	ppb	GCP	0.21	NO	7.82	0.03	0.20
16	PCB - 170	ppb	GCP	0.01	0.02	0.00	0.00	0.03
17	PCB - 196	ppb	GCP	0.00	0.02	0.03	0.00	0.11
18	PCB - 198	ppb	GCP	0.01	0.04	0.00	0.02	0.00
19	PCB - 195	ppb	GCP	0.01	0.01	0.05	0.02	0.07
20	PCB -194	ppb	GCP	0.00	0.01	0.26	0.00	0.05
21	PCB-209	ppb	GCP	0.00	0.00	0.02	0.01	0.11

Y1-1 =Soil Sample #1 from yard 1, Y1-2 =Soil Sample #2 from yard 1, Y1-3 =Soil Sample #3 from yard 1
Y1-4 =Soil Sample #4 from yard 1, Y1-5 =Soil Sample #5 from yard 1

Table A6.4 Hot Spot Soil Sample from Shipyard # 1

S.No	Parameters	Unit	Method	Y1H-1	Y1H-2
1	PCB –15	ppb	GCP	0.76	0.06
2	PCB – 101	ppb	GCP	0.11	0.07
3	PCB - 151	ppb	GCP	0.04	0.00
4	PCB - 118	ppb	GCP	0.00	0.01
5	PCB - 153	ppb	GCP	NO	0.00
6	PCB - 141	ppb	GCP	0.01	0.00
7	PCB - 138	ppb	GCP	0.01	0.00
8	PCB - 187	ppb	GCP	NO	0.00
9	PCB - 180	ppb	GCP	0.70	0.01
10	PCB - 170	ppb	GCP	0.12	0.01
11	PCB - 196	ppb	GCP	0.24	0.01
12	PCB - 198	ppb	GCP	0.06	0.00
13	PCB - 195	ppb	GCP	0.02	0.00
14	PCB -194	ppb	GCP	0.02	0.00
15	PCB-209	ppb	GCP	0.03	0.01

Y1H-1= Hot Stop Soil Sample from Cutting Area; Y1H-2= Hot Stop Soil Sample from Workshop

Table A6.5 Hot Spot Soil Sample from Shipyard # 2

S.No	Parameters	Unit	Method	Y2-1	Y2-2	Y2-3	Y2-4	Y2-5
1	Total Oil	mg/kg	Solvent extraction	4300.0	2811	3679	1025	1291
2	Cadmium	mg/kg	AAS	BDL	BDL	BDL	BDL	BDL
3	Chromium	mg/kg	AAS	13.61	16.97	11.72	2.42	BDL
4	Lead	mg/kg	AAS	197.7	117.74	107.0	11.3	BDL
5	Mercury	mg/kg	MassSpectrometer	0.101	0.092	0.098	0.086	0.078

Y2-1 =Soil Sample #1 from yard 2; Y2-2 =Soil Sample #2 from yard 2; Y2-3 =Soil Sample #3 from yard 2
Y2-4 =Soil Sample #4 from yard 2; Y2-5 =Soil Sample #5 from yard 2.

APPENDIX 7: INSTITUTIONAL ARRANGEMENTS

Table A7.1 Bangladesh

Ministry	Authority	Legislation/ Regulation	Action Controlled	Comment
Ministry of Shipping	Department of Shipping (DOS)	Bangladesh Merchant Shipping Ordinance, 1983	'No Objection Certificate' for scrap ships entry into Bangladesh waters.	Ratification of International Maritime Conventions is the duty of DOS. Presently DOS has no role at yard level.
Ministry of Shipping	Chittagong Port Authority	The Port Authority Act 1976	Beaching permission. Provision of tug if needed for dead ships	Subject to production of relevant documents and paying of taxes.
Ministry of Shipping	Mercantile Marine Department	Bangladesh Merchant Shipping Ordinance, 1983.	Ensure vessel fit for safe navigation with valid documents, competent crew members to successfully beach.	Court injunction on the issuance of clearance by the MMD as the ship breakers challenged its role.
Ministry of Environment and Forest (MOEF)	Department of Environment (DOE)	Environment Conservation Act, 1995; Environment Conservation Rules, 1997. Draft Environment Conservation Act (Amendment) 2009 prepared	Environmental Clearance Certificate (ECC), periodic inspection.	Equivalent to authorization of ship recycling facility. So far no ship recycling facility has obtained an ECC. DOE drafting rules for ship recycling sector due to 2009 Bangladesh High Court decision. DOE is not active at yard level.
MOEF	Department of Environment (DOE)	Environment Conservation Act, 1995; Environment Conservation Rules, 1997.	Hazardous and other waste treatment and disposal	Downstream environmental controls. Draft National 3R Strategy for Waste Management, 2009 is prepared by DOE.
Ministry of Labour and Employment (MOLE)	Department of Labour (DOL)	Bangladesh Labour Laws 2006	Working conditions and workers' health and welfare. Right to organize in trade unions, industrial relationships, etc.	A revision of BLL 2006 is underway by MOLE. Draft Occupational Safety and Health (OSH) policy under stakeholder consultation at present. DOL is not active at ship breaking yards mainly due to absence of trade union and lack of man power.
Ministry of Labour and Employment (MOLE)	Department of Inspection for Factories and Establishment (DIFE)	The Factories Act, 1965 and The Factories Rules, 1979	Registration of yards. Monitoring OSH status and compliance of registration requirements.	Most ship breaking yards are not registered as the industry is not formally declared by government as Industry. BLL 2006 mentions ship breaking yard as factory. DIFE activity is limited at ship breaking yards.
Ministry Power, Energy and Mineral Resource	Department of Explosives	Rule 38 of the Petroleum Rules, 1937. *Explosives Act*, 1884	Gas free certificate for ships	Ships inspected. Plays active role as Gas Free Certification is a mandatory requirement for beaching and cutting.
Defense Ministry	Bangladesh Navy		Inspects vessel ensures that communication equipment, radio, VHF, walkie-talkies etc. handed to government.	Done on safety and national security considerations.
Ministry of LGRD & Co-operatives	Upazila Parishad	Upazila Parishad Act, 2009	Trade license	Issues license for ship breaking trade. Most yards operate only with trade license.
Ministry of Finance	Bangladesh Customs	The Customs Act, 1969. Import and Export (Control) Act, 1950	Inspects ship at outer anchorage, charges taxes on taxable items on board, unused oil	
Ministry of Land	District Admin/ Commissioner	State Acquisition and tenancy act 1950	Lease government owned land. Collect annual fees for renewal.	

Table A7.2 Pakistan

Ministry	Authority / Department	Legislation/ Regulation	Action Controlled	Comment
Ministry of Ports & Shipping		No known legislation directly affecting ship breaking activities	None	Ministry of Ports and Shipping has no current role in ship breaking activities.
Ministry of Environment	Balochistan EPA	IEE /EIA requirement under Pakistan Environment Protection Act, 1997	"No Objection Certificate" (NOC) for import of ship	Provincial EPA enforces. Inspectors have power to visit and inspect ships before beaching. Have authority to visit/inspect ship breakings yards to ensure environmental compliance. IEE or EIA requirement depends upon the information available. Normally only IEE is required. EIA needed if EPA receives prior information that hazardous materials on ship being imported for recycling. Public hearing required for EIA.
Ministry of Environment	Balochistan EPA	Pakistan Environment Protection Act, 1997 and National Environmental Quality Standards	Ship Recycling Plan	IEE / EIA does include recycling plan, not as comprehensive as under HK Convention. At present not enforced strictly.
Ministry of Environment	Balochistan EPA	Pakistan Environment Protection Act, 1997 & National Environmental Quality Standards	Inventory of Hazardous Materials	Strictly speaking this should be part of IEE / EIA. However, due to lack of technical knowhow and capabilities of environmental consultants carrying out IEE/EIA as well as EPA, this aspect is generally ignored. **This new requirement under HK Convention – to be enforced after government ratification of the Convention.**
		No known legislation in place requiring Ship Breaking Yards Certification or authorization to start ship breaking and recycling activities	Ship Recycling Facilities Certification	Not monitored or controlled at present, no requirement to secure a certificate from a competent authority for beginning of ship breaking and recycling activities. **Under HK Convention – enforcement to begin after government ratification of the Convention.**
Ministry of Labour and Manpower	Various departments	Legislation covering Employees Old Age Benefits, Working Conditions, Sanitation, etc	Occupational Health and safety	Enforcement of labor legislation is weak. (i) Workforce do not wear PPE; (ii) poor/bad sanitation mainly because of lack of proper infrastructure
Ministry of Industries & Production		No active role or known legislation directly affecting operations of ship breaking activities at Gadani	None	

Ministry of Petroleum & Natural Resources		No active role or known legislation directly affecting operations of ship breaking activities at Gadani	None	Gas for cutting is procured from two multinational companies and so gas utility company or government department has no role. There is no routine inspection by Government regulatory authority or department on gas piping installed at yards.
	Oil & Gas Regulatory Authority (OGRA). Or Balochistan EPA	No known legislation in place that would require NOC or any kind of approval to begin cutting	NOC for Gas Free for Hot Works	Not monitored or controlled at the present state. **This is a new requirement under HK Convention – Not controlled at the present.** (Not yet clear which department/ authority would be involved)
		No known legislation in place that would require any kind of approval for starting ship breaking and recycling activities.	Ballast Water disposal	Not monitored or controlled at the present state.
Planning & Development Department, Balochistan Government	Balochistan Development Authority	Balochistan development levy / charges Renewal of lease for yards owned by BDA	"No Objection Certificate" (NOC) for starting ship breaking activities	NOC is required before ship breaking activities can be started. It is strictly enforced. NOC not issued if development levy /charges are outstanding.
Ministry of Finance, Economic Affairs, Statistics & Revenue	Revenue Division - Customs	Sales Tax [Sales Tax Notification SRO 678(1)/2007] Withholding Tax	"No Objection Certificate" (NOC) for starting ship breaking operations	NOC is required before ship breaking activities can be started. It is strictly enforced. Sales Tax payment schedule and withholding tax payment is necessary for issuance of NOC by Customs. Withholding tax is a fixed rate tax (1% of the value) charged regardless of profitability of the yards. It is strictly enforced.

APPENDIX 8: ACTIONS TO CLOSE COMPLIANCE GAP

ACTIONS TO CLOSE THE GAP: BANGLADESH

Key for Action Area

i) Institutional Capacity Building
ii) Supporting Infrastructure
iii) Facility Development – technical/infrastructure
iv) Facility Development Managerial

A) NO COST/ LOW COST (can take place with limited need for financial support but need policy/political commitment and incentives)

Specific Activity	Action Area	Prime Delivery Agent	HK Convention Compliance	Delivery Priority	Delivery Challenge/Barrier	Delivery Timescale	Cost (million USD)
Extending Plot leases	i)		None –facilitates industry investment	M	Policy change required; No practical change – most operators have long term presence.	1-2 year	**-**
Manage yard operations – cutting zones /oil spillage control/waste containment	iv)	Industry	Intermediate to HK Convention	H	Simple and achievable with yard operator commitment; Organizational change resistance; Need to introduce/improve signage.	1-2 year	**-**
Pollution control – oil booms	iii)	Industry	Intermediate	H	Need management control to deploy as required; Guidance on use and maintenance required; Dependent on waste disposal facility availability.	1 year	**0.1 per yard**
Preparation of Recycling Facility Management Plans	iv)	Industry	Full - Local example would be useful	M	Industry commitment required; Codify/document existing practices and modify in line with Convention; HKC Guidance needed.	1 -2 year	**0.25**
Action Plan for ratification of HK Ship Recycling Convention Implementation	i)	MoEF	Full	H	Essential precursor for Convention compliance; Requires strong political commitment.	1-2 y develop 2-5 years implement	**1.0**

B) LOW TO MEDIUM COST

Specific Activity	Action Area	Prime Delivery Agent	HK Convention Compliance	Delivery Priority	Delivery Challenge/Barrier	Delivery Timescale	Cost ($million)
Incorporation of ships POPS Management into Stockholm NIP (see Environmental Assessment also, below)	i)	MoEF	Full – Regulation	H	PCB management priority needs policy commitment; Coordination of relevant Ministry responsible officials.	1-2 years	**0.25**
Establish Ship Inspection Protocol	iv)	Industry	Partial	M	Needs coordinated action by yard owners and ship owners.	1-2years	**1.0**
Development of Training Tools for HKC – Requirements for Recycling Facilities	i)	MoEF/Dep Shipping/Training Institutes/UNITAR-UNDP	Intermediate	M	Dependent on production of Guidance to Convention; Needs stepwise introduction - managed program of training.	3-5 years	**1.5**
Local Healthcare facility	ii)	Health	Partial for worker heath and safety – assume Local "First Aid plus" facility	H	Land needed; Design/treatment level to be developed;Need to identify responsible body to commit to maintain.	1 year	**1.5**
Full Environmental Assessment of ship recycling yards and remediation feasibility study with POPS (PCB) balance characterization	i)	MoEF	Partial	H	Cooperation yard owners; Inter Ministry coordination required; Preferable to establish local analytical facility above; Potential cooperation with University of Chittagong.	1-2 year	**1.5**
Technical assistance for capacity building for Government departments with respect to compliance with the Articles and Regulations of the Convention	i)	Ministries: Shipping, Steel, Env Forest	Intermediate	H	Identifying actual standards - still being developed at IMO MEPC; Adaptable program of familiarization with Convention requirements as they are developed.	1-4 years	**2.0**
Develop and implement a National Ship Recycling Facility Improvement Plan consistent with aims and objectives of HKC	i)	MoEF	Intermediate	M	Necessary precursor to delivery of full compliance.	1-2 years	**2.0**
Establish analytical laboratory facility	ii)		Intermediate for simple monitoring Required for full compliance	M	Policy commitment needed; Land required; Technical skills training for routine sampling and analysis.	2 years	**2.0**
Develop and implement Training programs for inspection and enforcement	i)		Needed for full compliance Intermediate step to establish regular inspection	M	Policy commitment to commit staff resource; Establishment of technical and administrative systems and procedures; Training of all staff; Maintaining ongoing inspection program;	3-5years	**2.5**

Specific Activity	Action Area	Prime Delivery Agent	HK Convention Compliance	Delivery Priority	Delivery Challenge/Barrier	Delivery Timescale	Cost ($million)
			program		Enforcement action needs high level support and consistent approach; Staff turnover – regular training /new recruits needed.		
Establish Permanent training centre for the workers, to increase technical skills of the workers, develop competence regarding workplace hazards and risks.	i)	Joint Venture Ministry/Industry	Intermediate – will contribute to effective implementation	H	Policy Commitment and coordination – MoU; Identify land for building; Need to source and provide trained trainers.	3-5yeas	**3.0**
Cargo hold and tank cleaning operation	ii)	Industry	Intermediate	M	Needs wider support and use than just for ship recycling e.g. by Port Authority; Land availability (depot); Developing and retaining expertise; Needs waste treatment facility; Ensuring use - pricing needs to be competitive.	1-3 years	**3.0**
Development of Hazardous Waste Management Plan	i)	MoEF	Intermediate contributes to downstream waste management. Helps to deliver Basel Convention obligations	H	Policy commitment needed; Follow up required to implement the Plan	1-2years	**3.5**
Establish MARPOL Reception Facility at Chittagong Port	ii)	Dept Shipping	Intermediate – will contribute to effective implementation Delivers other IMO requirements (Port reception Facilities) maybe shared cost	H	Needs wider support and use than just for ship recycling e.g. by Port Authority; Land availability; Developing and retaining expertise; Ensuring use - pricing needs to be competitive.	2-4 years	**5.0**
Oil reclamation facility	ii)	Industry	Intermediate Helps to deliver Basel Convention obligations	M	Needs wider support and use than just for ship recycling; Identify strategic location and land issues – plant market and sizing requires feasibility study.	2-4 years	**5.0**

C) HIGH COST

Specific Activity	Action Area	Prime Delivery Agent	HK Convention Compliance	Priority	Delivery Challenge/Barrier	Delivery Timescale	Cost (million USD)
Pilot/Demonstration Green Facility (small ships)	ii)	MoEF/Industry Joint venture	Full	M	Low uptake risk; Uncompetitive; Suitable only to use as demonstration/training.	3-5years	**15.0**
Remediation of closed yards (general coastal zone environmental improvement)	i)	MoEF	-	M	Need results of Full Environmental Assessment survey (above); To identify extent of yards to be kept closed, establish plot leases, define future industrial zones; Establish remediation outcome, standard method, monitoring.	3-5 years	**10**
Establish Hazardous Waste Treatment Facility (inc. POPS and hazardous waste landfill disposal)	ii)	Ministry EF/Industry Joint venture	Full – fulfils HK Convention Contributes to other obligations: Basel Convention (hazardous wastes); Stockholm Convention (POPs); Montreal Protocol (CFCs).	H	Policy Commitment needed; Market uncertainties – uptake, need subsidy to maintain in early years; Depend on Hazardous waste Management Plan to identify available market; Setting location for strategic facility; Technical Expertise to maintain facility(ies) safely and efficiently.	3-5years	**25.0**
Pilot/Demonstration Green Facility (large ships)	ii)	MoEF/Industry Joint venture	Full	M	Low uptake; Uncompetitive; Suitable only to use as demonstration/training.	3-5years	**25.0**
Yard Housekeeping -Weighbridge -Impermeable surfaces -Drainage -Hazardous Waste storage -Mechanization - Lifting equipment	iii)	Industry	Full	H	Commitment of yard owners; Needs evaluation and implementation program as first step; Dependent on provision of downstream waste facilities.	1-5years depending on activity	**(per plot) 2.0-5.0**

ACTIONS TO CLOSE THE GAP: PAKISTAN

A) NO TO LOW COST (these can take place with limited need for financial support but need policy/political commitment and incentives)

Specific Activity	**Action Area**	**Prime Delivery Agent**	**HK Convention Compliance Fulfillment**	**Priority**	**Delivery Challenge/Barrier**	**Delivery Timescale**	**Cost (million USD)**
Extending Plot leases	i)		None – but facilitates industry investment	M	Policy change required; No practical change – most operators have long term presence.	1-2 year	**-**
Manage yard operations – cutting zones /oil spillage control/waste containment	iv)	Industry	Intermediate to HK Convention	H	Simple and achievable with yard operator commitment; Organizational change resistance; Need to introduce/improve signage.	1-2 year	**-**
Pollution control – oil booms	iii)	Industry	Intermediate	H	Need management commitment to deploy as required; Guidance on use and maintenance required; Dependent on waste disposal facility availability.	1 year	**0.1 per yard**
Preparation of Recycling Facility Management Plans	iv),	Industry	Full - Local example would be useful	M	Industry commitment required; Codify/document existing practices and modify in line with Convention; HKC Guidance needed.	1 -2 year	**0.25**
Action Plan for ratification of HK Ship Recycling Convention Implementation	i)	MoE	Full	H	Essential precursor for Convention compliance; Requires strong political commitment.	1-2 y develop 2-5 years implement	**1.0**

B) LOW TO MEDIUM COST

Specific Activity	Action Area	Prime Delivery Agent	HK Convention Compliance Fulfillment	Delivery Priority	Delivery Challenge/Barrier	Delivery Timescale	Cost (million USD)
Incorporation of ships POPS Management into Stockholm NIP	i)	MoE	Full – Regulation	H	PCB management priority needs policy commitment; Coordination of relevant Ministry responsible officials.	1-2 years	**0.5**
Establish Ship Inspection Protocol	iv)	Industry	Partial	–	Needs coordinated action by yard owners and ship owners.	1-2years	**1.0**
Development of Training Tools for HKC – Requirements for Recycling Facilities	i)	MoE/Dep Shipping/Training Institutes/UNITAR-UNDP	Intermediate	M	Dependent on production of Guidance to Convention; Needs stepwise introduction - managed program of training.	3-5 years	**1.5**
Local Healthcare facility	ii)	Health	Partial for worker heath and safety – assume Local "First Aid plus" facility	H	Land needed; Design/treatment level to be developed; Need to identify responsible body to commit to maintain.	1 year	**1.5**
Technical assistance for capacity building for Government departments with respect to compliance with the Articles and Regulations of the Convention	i)	Ministries: Shipping, Steel, Environment	Intermediate	H	Identifying actual standards- still being developed at IMO MEPC; Adaptable program of familiarization with Convention requirements as they are developed.	1-4 years	**2.0**
Development and implement a National Ship Recycling Facility Improvement Plan consistent with aims and objectives of HKC	i)	MoE	Intermediate	M	Necessary precursor to delivery of full compliance.	1-2 years	**2.0**
Establish analytical laboratory facility	ii)	Balochistan/Sindh EPA	Intermediate for simple monitoring Required for full compliance	M	Policy commitment needed; Land required; Technical skills training for routine sampling and analysis.	2 years	**2.0**
Develop and implement Training programs for inspection and enforcement	i)	Balochistan/Sindh EPA	Needed for full compliance Intermediate step to establish regular inspection program	M	Policy commitment to commit staff resource; Establishment of technical and administrative systems and procedures; Training of all staff; Maintaining ongoing inspection program; Enforcement action needs high level support and consistent approach;	3-5years	**2.5**

					Staff turnover – regular training /new recruits needed.		
Establish Permanent training centre for the workers, to increase technical skills of the workers, develop competence regarding workplace hazards and risks.	i)	Joint Venture Ministry/Industry	Intermediate – will contribute to effective implementation	H	Policy Commitment and coordination – MoU; Identify land for building; Need to source and provide trained trainers.	3-5yeas	**3.0**
Cargo hold and tank cleaning operation	ii)	Industry	Intermediate	M	Needs wider support and use than just for ship recycling e.g. by Port Authority; Land availability (depot); Developing and retaining expertise; Needs waste treatment facility; Ensuring use - pricing needs to be competitive.	1-3 years	**3.0**
Development of Hazardous Waste Management Plan	i)	MoE	Intermediate contributes to downstream waste management Helps to deliver Basel Convention obligations	H	Policy commitment needed; Follow up required implementing the Plan.	1-2years	**3.5**
Establish MARPOL Reception Facility at Karachi Port	ii)	Dept Shipping	Intermediate – will contribute to effective implementation Delivers other IMO requirements (Port reception Facilities) maybe shared cost	H	Needs wider support and use than just for ship recycling e.g. by Port Authority; Land availability; Developing and retaining expertise; Ensuring use – pricing needs to be competitive.	2-4 years	**5.0**
Oil reclamation facility	ii)	Industry	Intermediate Helps to deliver Basel Convention obligations	M	Needs wider support and use than just for ship recycling; Identify strategic location and land issues – plant market and sizing requires feasibility study.	2-4 years	**5.0**

C) HIGH COST

Specific Activity	Action Area	Prime Delivery Agent	HK Convention Compliance Fulfillment	Delivery Priority	Delivery Challenge/Barrier	Delivery Timescale	Cost (million USD)
Pilot/Demonstration Green Facility (small ships)	ii)	MoE/Industry Joint venture	Full	M	Low uptake risk; Uncompetitive; Suitable only to use as demonstration/training.	3-5years	**15.0**
Establish Hazardous Waste Treatment Facility (inc. POPS and hazardous waste landfill disposal)	ii)	MoE/Industry Joint venture	Full – fulfils HK convention Regulations Contributes to other obligations: Basel Convention (hazardous wastes). Stockholm Convention (POPs) Montreal Protocol (CFCs)	H	Policy Commitment needed; Market uncertainties – uptake, need subsidy to maintain in early years; Dependent on Hazardous waste Management Plan to identify available market; Setting location for strategic facility; Technical Expertise needed to maintain facility(ies) safely and efficiently.	3-5years	**25.0**
Pilot/Demonstration Green Facility (large ships)	ii)	MoE/Industry Joint venture	Full	M	Low uptake; Uncompetitive; Suitable only to use as demonstration/training;	3-5years	**25.0**
Yard Housekeeping -Weighbridge -Impermeable surfaces -Drainage -Hazardous Waste storage -Mechanization - Lifting equipment	iii)	Industry	Full	H	Commitment of yard owners; Needs evaluation and implementation program as first step; Dependent on provision of downstream waste facilities.	1-5years depending on activity	**(per plot) 2.0-5.0**

APPENDIX 9: LIST OF STAKEHOLDERS

Bangladesh

Government Ministries & Departments

Ministry of Environment & Forests
Ministry of Labour & Employment
Chittagong Authorities (Mayor's Office)
Department of Inspection for Factories & Establishments
Ministry of Shipping
Department of Environment
Department of Shipping

Industry

Bangladesh Ship Breakers' Association (BSBA)
Individual Ship breakers/Professionals

IGOs/NGOs/others

ILO
World Bank office Dhaka
Bangladesh Environmental Lawyers Association
Young Power in Social Action (YPSA)
Bangladesh Occupational Safety, Health and Environment Foundation (OSHE)
UNDP
Norwegian Royal Embassy
Bangladesh Institute of Labor Studies (BILS)

Academia

University of Chittagong
Asian University for Women

Pakistan

Government Ministries

Ministry of Environment
Ministry of Commerce
Federal Board of Revenue
Marine Pollution Control Department, Karachi Port Trust
Ministry of Ports & Shipping
Ministry of Industry
National Institute of Oceanography

Local Government

Balochistan Environmental Protection Agency
Balochistan Development Authority
Sindh Environmental Protection Agency

Industry

Pakistan Shipbreakers' Association

IGOs/NGOs

UNDP
ILO
WWF in Karachi & Islamabad
Pakistan Fisherfolk Forum
UNIDO
World Bank Islamabad office
Pakistan Wetlands Programme

APPENDIX 10: DESCRIPTION OF SELECTED COUNTRY PRIORITY ACTIONS

BANGLADESH

A) Training and train-the-trainers. Training is required on all subjects: safety, occupational health, public health, and environmentally sound operations. A potential NORAD project may address some of these issues and establish a training center at Chittagong. A proposal is under consideration by the government, but the status of the project is not yet certain.

A number of facilities in Chittagong have developed Ship Recycling Facility Plans covering aspects such as worker safety and training, protection of human health and the environment, roles and responsibilities of personnel, emergency preparedness and response and monitoring, and reporting and record-keeping systems (in line with requirements under the Hong Kong Convention). But these systems largely exist only on paper. Training and guidance is required for the implementation of such Facility Plans.

The World Bank could consider adding to the project a POP component directed toward identification, risk reduction, and management of PCBs, including aspects of emergency preparedness and treatment of exposed workers.

Beneficiary: DOE Chittagong and Occupational Health authorities

Other stakeholders: Industry association; collaboration with Pakistan; Shipbreaking Association in Aliaga, Turkey

Possible financing: Global Environment Facility (GEF), NORAD.

B) Better Work Pilot Programme. The Better Work Programme is a partnership between the ILO and the International Finance Corporation (IFC) to improve practices based on core ILO labor standards and national labor law in targeted countries and industries. The program seeks to match “compliant” industries or suppliers with a responsible buyer network. In 2010, the ILO will investigate the feasibility of including ship breaking in the Better Work Programme, with a particular focus on the industry in Pakistan and Bangladesh. As an extension to a Green Certification Scheme, standards could be developed for the industry on occupational health and safety and on labor.

Beneficiary: Industry (both suppliers and buyers)

Possible financing: ILO/IFC Better Work Programme

C) Development of a national strategy for the environmentally sound management of hazardous wastes. Bangladesh has insufficient infrastructural capacity to manage hazardous waste. Crucial to developing facilities for this purpose is the development of a national hazardous waste management strategy, which would focus on the development of a national hazardous waste inventory (from all industries, not just ship breaking), defining needs in relation to the environmentally sound management of hazardous waste and identification of strategies, facilities, and technologies to address these needs.

Beneficiary: Ministry of Environment and Forest, DOE Chittagong.

D) Develop MARPOL reception facilities in Port of Chittagong. Ships for recycling most often call at Chittagong or anchor outside of it for approvals and so on. This presents an opportunity for performing various pre-demolition cleaning activities such as emptying bilge tanks, paint and chemical stores, waste oil, and solvents holds. To manage the operationally generated waste of ships calling at the Port of Chittagong, in particular ships on their final voyage to the beach, the development of MARPOL reception facilities is proposed. Such facilities may, in the light of the particular situation as the final port of call, be supplemented with capacity for solid waste and non-operationally generated waste, forming a broader cost recovery base.

A part of this would be to develop a Port Waste Management Plan. That would serve not only ships for scrap but also ordinary merchant vessels. This plan is prepared to secure cost-efficient ship waste handling without causing the ships undue delay. Providing efficient waste collection can prevent undue delay, but most often a number of other issues need to be clarified in order to ensure cost-efficient and transparent ship waste handling in a port. The IMO recommends the preparation of such Port Waste Management Plans in order to secure efficient ship waste handling. Besides ship-generated waste, such plans also deal with other wastes brought in by ships, which cannot be classified as “ship-generated.”

Beneficiary: Port of Chittagong

Other stakeholders: DOE Chittagong

Possible financing: Transport infrastructure program

E) Cargo hold and tank cleaning company. Other than falls, the greatest occupational health hazard in ship recycling is presented by work in tanks and enclosed spaces. Fatalities and injuries from explosions of vapors, typically in cargo tanks, and from asphyxiation after entering into low-oxygen atmospheres in enclosed spaces are common in the industry. Better enforcement of hot work and enclosed space certificates will help, but assistance in cleaning and preparing the areas on the ships for safe work may also be promoted. It is proposed to assist, through the private sector program, the establishment of a company offering cargo hold and tank cleaning services. This may also include a common facility for reclamation of oil, possibly based on the Turkish model at Aliaga, Izmir.

Other stakeholders: Ship Breaker’s Association, Port of Chittagong

Financing: Private sector program.

PAKISTAN

A) Training and train-the-trainers. Training in occupational health and environmental management is needed for the facility managers, supervisors, and the work force. Training and guidance is required for the development and implementation of Ship Recycling Facility Plans for facilities covering aspects such as worker safety and training, protection of human health and the environment, roles and responsibilities of personnel, emergency preparedness and response, and monitoring, reporting, and record-keeping systems (in line with requirements under the Hong Kong Convention). A central facility needs to be developed to assist industry and authorities and to train in hazardous materials inventories on ships and hazardous materials management on shore. Includes identification, sampling, analysis, and management of hazardous materials, in particular POPs, ODS, TBT, asbestos, and heavy metals.

May be combined with a pilot green recycling facility (see below).

Beneficiary: Balochistan EPA and Occupational Health authorities

Other stakeholders: Industry association. Collaboration with Bangladesh and possibly Turkey

Possible financing: GEF, ILO

B) Development of a regulatory framework, building institutional capacity and strengthening enforcement. The Ministry of Environment has cited the need to develop a regulatory framework in relation to ship breaking (in line with the requirements of the Hong Kong and other relevant Conventions) and to build institutional capacity for the implementation and enforcement of such regulations and guidelines.

Beneficiary: MOE, BEPA

Financing: SBC/IMO/ILO Global Programme for Sustainable Ship Recycling

C) Development of a national strategy for the environmentally sound management of hazardous wastes. Pakistan has insufficient infrastructural capacity to manage hazardous waste. Crucial to developing facilities for this purpose is the development of a national hazardous waste management strategy, which would focus on the development of a national hazardous waste inventory (from all industries, not just ship breaking), defining needs in relation to the environmentally sound management of hazardous waste and identification of strategies, facilities, and technologies to address these needs. The U.N. Industrial Development Organization (UNIDO, implementing agency of "One UN" Joint Programme (Environment) Component 5 on Green Industries, Industrial Waste Management, Energy and Green Jobs) has expressed interest in a partnership with the World Bank to specifically address waste management issues in coastal regions.

Beneficiary: MOE, BEPA

Possible financing: SBC/IMO/ILO Global Programme for Sustainable Ship Recycling, UNIDO

D) Green Certification Scheme. Ship breakers are particularly interested in the establishment of a Green Certification Scheme, citing specific criteria and standards for facilities to meet to be certified as "green." This may attract green recycling business before the Hong Kong Convention enters into force and may be used as a best practice yard. Access to assistance with preparations for certification may be funneled through a common funding program.

Beneficiary: Industry

Possible financing: World Bank Private sector program, ILO/IFC Better Work Programme

E) Better Work Pilot Programme. The Better Work Programme is a partnership between the ILO and the IFC to improve practices based on core ILO labor standards and national labor law in targeted countries and industries. The program seeks to match "compliant" industries or suppliers with a responsible buyer network. In 2010, the ILO will investigate the feasibility of including ship breaking in the Better Work Programme, with a particular focus on the industry in Pakistan and Bangladesh. As an extension to a Green Certification Scheme, standards could be developed for the industry on occupational health and safety and on labor.

Beneficiary: Industry (both suppliers and buyers)

Possible financing: ILO/IFC Better Work Programme

F) Develop MARPOL reception facilities in Port of Karachi. Ships for recycling most often call at Karachi or anchor outside of it for approvals and so on. This presents an opportunity for performing various pre-demolition cleaning activities such as emptying bilge tanks, paint and chemical stores, waste oil, and solvents holds. To manage the operationally generated waste of ships calling at Port of Karachi, in particular ships on their final voyage to Gadani, the development of MARPOL reception facilities is proposed. Such facilities may, in the light of the particular situation as a port of final call, be supplemented with capacity for solid waste and non-operationally generated waste, forming a broader cost recovery base. A part of this would be to develop a Port Waste Management Plan. That would serve not only ships for scrap but also ordinary merchant vessels. This plan is prepared to secure cost-efficient ship waste handling without causing the ships undue delay. Providing efficient waste collection can prevent undue delay, but most often a number of other issues need to be clarified in order to ensure cost-efficient and transparent ship waste handling in a port. The IMO recommends the preparation of such Port Waste Management Plans in order to secure efficient ship waste handling. Besides ship-generated waste, such plans also deal with other wastes brought in by ships, which cannot be classified as "ship-generated."

A first action will be to assist the Port Authorities to develop a Port Waste Management Plan featuring the investment profile needed.

Beneficiary: Port of Karachi

Other stakeholders: Sindh EPA

Possible financing: Transport infrastructure program

G) Cargo hold and tank cleaning company. Other than falls, the most serious occupational health hazard in ship recycling is presented by work in tanks and enclosed spaces. Fatalities and injuries from explosions of vapors, typically in cargo tanks, and from asphyxiation after entering into low-oxygen atmospheres in enclosed spaces are common in the industry. Better enforcement of hot work and enclosed space certificates will help, but assistance in cleaning and preparing the areas on the ships for safe work may also be promoted. It is proposed to assist, through the private sector program, the establishment of a company offering cargo hold and tank cleaning services.

Beneficiary: Industry

Other stakeholder: Ship Breaker's Association, Port of Karachi

Possible financing: Private sector program.