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Sustainable Shipping and Port Development

Uwe Breitling
GTZ Team Leader

Sustainable Port Development in the ASEAN Region ¹

Port Authority of Thailand (PAT), Podium Building, 3rd floor, Room 304
444 Tarua Road, Klong Toey, Bangkok 10110, Thailand

T: +66 (0) 2 269 5844 / M: +66 (0) 86 900 6263 / uwe.breitling@gtz.de / www.gtz.de

Shipping and port development

Shipping and ports are essential components of the international trade and goods movement. Shipping represents one of the largest, most difficult to regulate and control source of air and water pollution in the world. Ports are major economic, industrial and logistics centers that also contribute significantly to pollution in coastal urban areas. The air quality impacts of shipping and port activities are significant, especially the large emissions of diesel exhaust, particulate matter (PM) and nitrogen oxides.

Despite the fact that ships are more energy efficient than other forms of commercial transportation, marine engines operate on extremely dirty fuels. Most large ships use the dirtiest and least expensive diesel available. Known as bunker oil, this fuel is the collection of residue from the production of higher grade fuels and contains significant concentrations of toxic compounds banned from use in most other industrial and consumer applications. It is thick as asphalt and must be heated to be burned. To compound the problem, engines on ocean-going ships are currently not required to meet air pollution controls and standards as cars and trucks are required to do in many countries. Ocean-going ships now consume about 4% of world fossil fuels.

A fraction of the conventional pollutants produced by shipping – primarily sulfur oxides, nitrogen oxides and particulates – are released far from land; but an estimated 70 to 80% of is released is within 400 km from land. The emissions generated from shipping endanger biological diversity, natural resources and human health in the communities surrounding ports, coastal communities, in regions along inland waterways and even inland areas

¹ The principal objective of the technical cooperation project is to assist ports in shifting the emphasis from mere reactive complying with minimum standards to a pro-active approach to achieve quality and sustainability in safety, health and environmental (SHE) management performance. The project started in August 2009 and includes ports in Thailand, Vietnam, Cambodia, Philippines, Malaysia, Indonesia and Timor-Leste. The project supports the participating ports in collaboration with the Association of ASEAN Port Authorities (APA) and the Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) to implement sustainable management systems for the mitigating SHE risks in accordance with international standards and conventions.



through emissions transport. Ships' waste, sewage, oil, ballast water and the improper handling of dangerous goods in ports endanger human health of rising coastal populations, biological diversity and natural resources of sensitive coastal zones as well as livelihoods from coastal fishing to tourism.

Some progress has been made during in the last decades to reduce the environmental impact of maritime transport in some regions. However, this progress is neutralized by the tremendous growth of seaborne trade, the strong pressure on ports to handle the additional traffic, and the increasing global shortage of both qualified seafarers and port workers.

The international shipping and port industry is responsible for the carriage and handling of approximately 90% of world trade. In 2009, world seaborne trade exceeded 8 billion tons compared to 4 billion tons in 1990, 3.7 billion in 1980 and 2.6 billion in 1970. It is expected to double or triple in some areas by 2020. The number of containers handled in the world's ports increased from less than 100 million twenty-foot equivalent units (TEU) in 1990 to more 506 million TEU in 2008. Mainland Chinese ports accounted for approximately 23% of the total world container port throughput.²

In 2009, the world merchant fleet reached 1.19 billion deadweight tons (dwt), comprising a total of 53,005 ships:³

- general cargo ships (17,104)
- bulk carriers (7,787)
- container ships (4,678)
- tankers (14,095)
- passenger ships (6,839)
- other (2,502)

Environmental impact of shipping and ports

Increased seaborne trade means more ships and increased risks of collisions, accidental and operational oil spills, air pollution and other threats to the environment. Shipping has a wide range of negative effects on the environment and the health of coastal populations. Well-known disasters with tankers like the *Exxon Valdez* (1989) *Erika* (1999) and *Prestige* (2001) come directly to mind. However, these accidents only form the tip of the shipping pollution iceberg:

- Most of the harmful emissions come from the daily operational release of various substances. Intentional and unintentional discharges of oil, chemical cargo residues, waste (often highly toxic), sewage, cleaning agents, anti-fouling paint, exhaust and other air emissions, and non-indigenous species from ballast water have an ongoing adverse impact.

² United Nations Conference on Trade and Development (UNCTAD): [Review of Maritime Transport 2009](#)

³ Source: Lloyd's Register Fairplay, July 2009



- The U.S. National Academy of Science (NAS) estimates that each year ships deliberately dump more than 6 million tons of garbage and release more than 600,000 tons of oil and oily wastes into the sea. Operational tanker oil discharges (i.e. dumping of oil during tank cleaning operations) form about 45% of the total ocean oil pollution in the world while ship and oil platform accidents contribute only 5% and 2% respectively. ⁴
- In 2007, the International Maritime Organization (IMO) assessed that the annual operational oil discharges of ships (fuel oil sludge, bilge oil and cargo-related discharges) exceeds 200 million tons. ⁵
- Recent studies indicate that the emission of CO₂, NO_x, and SO₂ by ships correspond to about 3 to 4%, 10 to 15%, and 4 to 9% of global anthropogenic emissions, respectively. ⁶
- According to the latest study of IMO, shipping is estimated to have emitted 1,046 million tons of CO₂ in 2007 – this corresponds to 3.3% of the global emissions during 2007. Exhaust gases are the primary source of emissions from ships. Mid-range emissions scenarios show that, by 2050, in the absence of policies, CO₂ emissions of shipping may grow by 150% to 250% (compared to the emissions in 2007) as a result of the growth in shipping. ⁷
- The above IMO study also reveals that other pollutants from shipping are rising even faster than CO₂ emissions. Sulphur and soot emissions, which give rise to lung cancers, acid rain and respiratory problems, are expected to rise more than 30% over the next 12 years.
- The health effects of air pollutants caused by shipping and port activities to residents of local communities include asthma, other respiratory diseases, cardiovascular disease, lung cancer, and premature mortality. Shipping-related particulate matter (PM) emissions are responsible for approximately 60,000 cardiopulmonary and lung cancer deaths annually, with most deaths occurring near coastlines in Europe, East Asia, and South Asia. Under current regulation and with the expected growth in shipping activity, it is estimated that annual mortalities could increase by 40% until 2012. ⁸

⁴ National Academy of Sciences NAS: [Oil in the Sea III: Inputs, Fates, and Effects](#) (2003)

⁵ GESAMP (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection): [Estimates of Oil Entering the Marine Environment from Sea-based Activities](#) (2007)

⁶ Organization for Economic Co-operation and Development (OECD): [Globalisation, Transport and the Environment](#) (2010)

⁷ International Maritime Organization (IMO): [Second IMO GHG Study](#) (2009)

⁸ James Corbett, James J. Winbrake, Erin H. Green, Prasasad Kasibhatla, Veronica Eyring and Axel Lauer: [Mortality from Ship Emissions: A Global Assessment](#), Environmental Science & Technology / Vol. 41, No. 24, American Chemical Society (2007)



Ports are busy commercial, industrial and transport nodes playing a key role in the economic development of their countries and regions. However, the concentration of shipping, land transport, port operation and development activities in a relatively small area represents serious safety hazards and risks of environmental deterioration. Structural, operational or accidental pollution of water, soil and air may result from ship accidents, bunkering, cargo handling and storage, port maintenance, port industrialization and port development.

Despite sophisticated innovations in cargo handling equipment and methods, port work is still considered as one of the most dangerous land-based occupations with accident rates much higher than other high risk industries. The underlying causes of the high accident rates are the inherent danger of port work and the often inadequate management control, training and risk assessments compounded by the increasing commercial pressures on ports and terminals for a quick turnaround of vessels.

Between 2000 and 2007, the value of world trade grew 12%, whilst total freight costs during this period increased by around half this figure, demonstrating the falling unit costs of transportation, including those of ocean freight. The international shipping associations proudly announce that '*In addition, total freight costs in world trade still represent, on average, less than 6% of the import value (or shelf price) of consumer goods*'.⁹ However, they forget to mention that ocean freight rates of maritime transport can be kept low, because they do not include any costs related to the huge negative environmental impacts of shipping and ports of which the general public is normally not aware of.

Regulation and control of ship-source pollution

Much of the tremendous and continuous marine pollution could be prevented if coastal states and their ports would provide adequate treatment facilities for ship-generated oily and solid wastes, sewage, toxic cargo residues and ballast water in accordance with the provisions of the two principal international conventions dealing with vessel-source pollution: The United Nations Convention on the Law of the Sea (UNCLOS 1982) and the International Convention for the Prevention of Marine Pollution from Ships (MARPOL 1973). Although most states have ratified these important international conventions, a large number of governments is either not willing or not able do not meet their obligations as flag, port and coastal state with regard to the control and reduction of vessel-source pollution.

States have three options to take action to reduce and control vessel-source pollution of the sea in order to preserve the marine environment:

- First, a state may take measures as a *flag state* with regard to its vessels. As such, it can prohibit national ships to discharge harmful substances. It may enact provisions for the construction and equipment of national ships with a view to minimize pollution. Flag states are responsible for ensuring their vessels' compliance with applicable safety, security, and environmental standards, and for verifying the accuracy of documents and certificates issued under their authority. This responsibility requires flag states to have the necessary domestic laws, administrative infrastructure, and

⁹ The Round Table of International Shipping Associations: [Shipping Facts](#) (2010)



qualified personnel in place to oversee vessel inspections, ensure crew competency, investigate vessel accidents, and take appropriate regulatory and enforcement actions.

- Second, states may take action as a *port state* by exercising their authority to ensure that foreign flag vessels visiting their ports are in compliance with applicable international and domestic requirements. This verification process, exercised through port state control programs, has taken on added significance given the failure of some vessel owners and flag states to effectively exercise their oversight responsibilities. As a corollary, a state may extend its facilities for the reception of operational waste from ships to foreign ships visiting its ports.
- Third, a *coastal state* may apply national provisions to ships navigating near its coasts. National legislation extends to the territorial sea and applies to ships navigating there. Thus, a state may prescribe the discharge of harmful substances from any ship, in its territorial sea, regardless of its flag.

Flags of convenience and substandard shipping

Four countries (Japan, Greece, Germany and China) own and control about 50% of the world's deadweight tonnage. However, between 60% (China) and 93% (Japan) of this tonnage is registered under a foreign flag – most of them known as 'open registries' or 'flags of convenience'. Flags of convenience are generally less concerned about and sensitive to environmental protection and labor, safety and fiscal standards. In 2009, 52% of the world's total deadweight tonnage was registered under six flags of convenience (Panama, Liberia, Marshall Island, Bahamas, Malta and Cyprus).¹⁰

Open registries allow ship owners to register vessels and fly their flag without any genuine link between the nationality of the owner and the flag state. Most of the flags of convenience have little interest in the duties of a flag state, other than to collect registration fees. They also lack the required resources and capacities to fulfill its flag state responsibilities with regard to enforcement and compliance with the provisions of UNCLOS, MARPOL and other important international maritime safety and environmental conventions, standards and regulations. Open registries are havens for owners of substandard vessels seeking to avoid meaningful oversight. The ability to rapidly change vessel registry from one flag state to another makes it easy for irresponsible owners to avoid effective flag state controls over their operations.

Most ship owners and operators have chosen to comply with the international environmental and safety regulations. The real problem lies with a relatively small percentage of vessels and owners that persist in consistently operating their vessels in full contravention to international environmental and safety regulations. It is estimated that between 5,000 and

¹⁰ United Nations Conference on Trade and Development (UNCTAD): [Review of Transport 2009](#)



7,500 substandard commercial vessels are polluting the seas through their non-compliance with international environmental regulations.¹¹

Insofar as such owners and operators are able to avoid paying for equipment, operations, crew and waste disposal costs, they derive an unfair competitive advantage over other ship owners and operators. If substandard operators are able to derive a competitive advantage from non- or partial-compliance with environmental regulations, it is often because they feel that this course of action is worth the risk. That is, attractiveness of substandard shipping and the financial benefits from non-compliance more than outweighs the chances of being caught and any financial penalties they might face if discovered.

Strategies and options for sustainable shipping and port development

The shipping and port industry has started to recognize that sustainability is good for profitability and to respond to the growing environmental and social concerns of clients and the communities in which it operates. During the last years shipping companies, port operators and authorities, port and shipping associations, research institutes, and government and environmental agencies have developed and implemented strategies, initiatives and programs, tools, guidelines and systems that address issues related to sustainable shipping and port operations and environment:

- air quality
- climate change
- water quality
- waste handling
- dredging
- energy conservation and renewable energy
- natural resources
- sustainability
- environmental management systems

The links on the following pages lead to selected organizations, associations and agencies and the policies strategies, initiatives, programs, tools, guidelines and systems they have developed during recent years that may assist in decision-making processes orientated towards sustainable development in the shipping and port industry. The main drivers for achieving improvements are environmental management systems, policy instruments, application of innovative technologies or a mixture of them.

¹¹ Organization for Economic Co-operation and Development (OECD): [Cost Savings Stemming from Non-Compliance with International Environmental Regulations in the Maritime Sector](#) (2003)



Air Pollution & Climate Secretariat (AirClim) / European Environmental Bureau (EEB) / European Federation for Transport and Environment (T&E)

- [Market-based instruments for NOx abatement in the Baltic Sea](#) (2009)

American Association of Port Authorities (AAPA)

- [Environmental Management Handbook](#) (1998)

Carbon Disclosure Project

- [Carbon Disclosure Transport Report](#) (2010)

Clean Shipping Project

- [Clean Shipping Index Guidance Document](#) (2010)
- [Clean solutions for ships – Examples from the Port of Göteborg](#) (2006)

Civic Exchange

- [Green Harbours: Hong Kong and Shenzhen – Reducing Marine and Port-related Emissions](#) (2008)

CE Delft / Germanischer Lloyd / MARINTEK / Det Norske Veritas

- [Greenhouse Gas Emissions for Shipping and Implementation Guidance for the Marine Sulphur Directive](#) (2006)

Det Norske Veritas (DNV)

- [Pathways to low carbon shipping – Abatement potential towards 2030](#) (2009)

Environmental Defense Fund

- [Floating Smokestacks - A call for action to clean up marine shipping pollution](#) (2008)

Études et Recherches en Transport:

- [Restructuring the Maritime Transportation Industry: Global Overview of Sustainable Development Practices](#) (2007)

European Commission (EC)

- [Thematic Research Summary: Waterborne Transport](#) (2010)
- [Evaluation of the Feasibility of Alternative Market-Based Mechanisms To Promote Low-Emission Shipping In European Union Sea Areas](#) (2004)

European Federation for Transport and Environment (T&E)

- [Bunker fuels and the Kyoto Protocol: How ICAO and the IMO failed the climate change test](#) (2009)

International Association of Ports and Harbors (IAPH) / World Ports Climate Initiative (WPCI)

- [Onshore Power Supply](#) (2010)



- [Air quality and Greenhouse Gas Tool Box](#) (2009)
- [World Ports Climate Initiative](#) (2008)

International Council on Clean Transportation (ICCT)

- [Air Pollution and Greenhouse Gas Emissions from Ocean-going Ships: Impacts, Mitigation Options and Opportunities for Managing Growth](#) (2007)

International Finance Corporation

- [Environmental, Health, and Safety Guidelines for Ports, Harbors, and Terminals](#) (2007)

International Institute for Sustainable Seaports / Global Environment & Technology Foundation

- [Inventory of Innovative Technologies for the US Seaports](#) (2010)
- [Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices](#) (2010)

International Maritime Organization (IMO)

- [Prevention of Air Pollution from Ships - Second IMO GHG Study](#) (2009)
- [Main events in IMO's work on limitation and reduction of greenhouse gas emissions from international shipping](#) (2008)

Oceana

- [Shipping Impacts On Climate: A Source With Solutions](#) (2008)

Organization for Economic Co-operation and Development (OECD) / International Transport Forum

- [Globalisation, Transport and the Environment](#) (2010)
- [Greenhouse Gas Emissions Reduction Potential from International Shipping](#) (2009)
- [Environmental Impacts of Increased International Maritime Shipping – Past trends and future perspectives](#) (2008)
- [Policy Instruments to Limit Negative Environmental Impacts from Increased International Transport - An Economic Perspective](#) (2009)

Partnership in Environmental Management in the Seas of East Asia (PEMSEA)

- [Port Safety and Health and Environmental Management \(PSHEM\) Code](#) (2007)

Pew Center on Global Climate Change

- [Marine Shipping Emissions Mitigation](#) (2010)

Port of Oakland

- [Maritime Air Quality Improvement Plan](#) (2009)



United Nations Environment Programme (UNEP)

- [Marine Litter: A Global Challenge](#) (2009)

United States Environmental Protection Agency (EPA)

- [Ports Sector Strategies](#)
- [Options for the Marine Ports Sector: Green Strategies for Sustainable Ports](#) (2008)
- [Port Technologies and Management Strategies](#) (2010)
- [Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories](#) (2009)
- [An Environmental Management System \(EMS\) Primer for Ports: Advancing Port Sustainability](#) (2009)
- [USA Harbor Craft Marine Technology](#) (2010)
- [NYC Private Ferry Fleet Emissions Reduction Technology Study And Demonstration](#) (2006)
- [Clean Ports USA: Navigating Toward Cleaner Air](#) (2005)
- [Emission Reduction Incentives for Off-Road Diesel Equipment Used in the Port and Construction Sectors](#) (2005)

World Shipping Council

- [The Liner Shipping Industry and Carbon Emissions Policy](#) (2009)

World Trade Organization (WTO)

- [Trade and Climate Change](#) (2009)