# IMPACT OF SHIP RECYCLING ON CIRCULAR ECONOMY- A CASE STUDY OF ALANG-SOSIYA SHIP- RECYCLING YARD, ALANG, GUJARAT

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## ABSTRACT

*Ships after serving for, on an average of 25 years will be decommissioned from service as they reach their end of life (EOL) [2]. The decommissioned ships are useful in many ways. For the creation of wealth from dismantling of the decommissioned ships by reusing the materials and recycling by melting the scrap iron into steel rods and sheets by re-rolling mills as per requirements for use in construction and others.[3]Additionally, dismantling decommissioned ships can be used as an alternative to ship breaking, such as sinking the ships to create artificial reefs that shelter various species of marine life, protecting biodiversity, and serving as a diving spot for adventurous tourism. Further, it is to be noted that decommissioned ships can be converted into floating hotels, museums, libraries, educational institutions and training centres, floating hospitals, art galleries, holding carnivals and cultural gatherings, exhibitions, short-distance cruises, etc., which attract tourists and promote businesses, and provide employment opportunities for many and generate revenue. By recovering valuable materials, recycling provides economic benefits through the sale of recycled products. The materials recovered, such as steel and aluminium, are in high demand in industries like construction, automotive, and manufacturing. Further, it is pertinent to mention that reducing waste and pollution, as well as promoting the reuse of materials, helps protect marine and terrestrial ecosystems from degradation caused by ship disposal. Several ISO standards are designed to improve safety and environmental performance in ship recycling. The ISO 30000 series outlines best practices and standards for ship recycling facilities[4]. Sustainability of natural resources can be achieved through the ship's circular economy by saving the fresh iron ore, cutting down trees for wood to be used in new ships. Thus, the dismantled ships are great*

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[2] Rousmaniere, et. al. "Ship breaking in the Developing World: Problems and Prospects." Int'l J. Occup. & Envtl. Health, vol. 13, 2007, pp. 359–68.
[3] Fischer-Kowalski, 1998
[4] International Organization for Standardization. (2009). ISO 30000:2009 - Ship recycling management systems Requirements for bodies providing audit and certification of ship recycling management systems. ISO.

*examples for the circular economy by reusing and recycling the decommissioned ships by creating wealth and employment opportunities in many sectors depending on the ship recycling yards. The authors adopts both doctrinal and non-doctrinal method for the study.*

**Keywords**: Decommissioned ships, dismantling, recycling, artificial reefs, floating hotels, bio diversity, carnivals, rerolling mills, exhibitions.

## INTRODUCTION

The circular economy is an economic model that makes the maximum utilization of resources by reusing, refurbishing, repairing etc which reduces the disposable waste and creating wealth from waste. Sustainable development growth and pollution free environment can be achieved through the circular economy by saving fresh raw materials and the resources required for converting the raw materials into finished and semi-finished goods. Making any product or material for circular usage, the product should be designed for longevity which reduces the remaking of the same which saves usage of raw materials and others. The product should be manufactured keeping in view of reusing it for other purposes as a part of circular economy. Products or materials used in the manufacturing process should be recyclable, for instance Glass, plastic, iron products, etc., can be recycled repeatedly for various purposes by creating wealth from waste in a circular economy[5].

The main advantages of the circular economy are sustainability, employment a clean environment, and creating wealth from waste. By recycling and reusing the materials fresh raw materials can be saved for future generations. The recycling process creates direct and indirect employment in the procurement, processing, marketing, logistics, banking, and insurance areas. It also develops innovative thinking and ideas for maximum utilization of a product or material. Circular economy faces certain challenges, such as a lack of awareness among the public about the circular economy, technical barriers for reusing and recycling the products and materials and government policies. For example, the decision of the Government to scrap old motor vehicles due to their high pollution, but these old vehicles can be reused by converting them with minor repairs and technological changes into electric vehicles without totally scrapping them as waste.

[5] Anthi Pournara et al, Circular Economy in the Shipbreaking Industry: Recovery of Precious Materials and Opportunities of Utilization by the Industrial Sector. Case Study of Steel, Online Symposium on Circular Economy and Sustainability, 2020.

## CIRCULAR ECONOMY UNDER SHIP-RECYCLING

Ship recycling is the best example of the circular economy. Ships are made up of different materials mainly of steel, copper, bronze, aluminium etc. Decommissioned ships are dismantled mainly for the recovery of valuable materials, recoverable parts for reusing and recycling, which has attained the status of ship recycling industry by providing huge employment in direct ship breaking and recycling factories involving various service sectors. Different types of cargo ships, oil containers, bulk carriers, passenger liners, warships etc., serve for 20-30 years or on average of 25 years reach their End-Of-Life(EOL) depending on the size, usage, accidents, cyclones,

EOL ships are decommissioned from service and are sold/sent for ship breaking and ship recycling purpose to ship recycling yards, known as ship's grave-yard to recover valuable materials and dispose waste in an environment-friendly manner to protect the environment from toxic pollutants from dismantling of the ships.

Further, this ship breaking, also known as ship demolition, refers to the process of dismantling decommissioned ships to recover valuable materials, recycle components, and dispose of hazardous substances. [6]The nature of ship breaking involves both the dismantling of the ship's structure and the careful management of hazardous waste, such as oil, asbestos, and heavy metals that the vessel may contain. While the recycling of metals and materials from old ships is economically important, the process is not without its challenges. [7]Environmental concerns regarding the contamination of ecosystems, as well as safety issues related to worker conditions in ship-breaking yards, make this industry both crucial and controversial[8].

## ADVANTAGES OF SHIP BREAKING AND RECYCLING

The major advantages of ship breaking are the material recovery, such as steel and non-ferrous metals, and ferrous metals. [9]and other valuable components. The materials such as brass, bronze, and even

[6] Emil Mathew, Recycling of Ships Act 2019: Challenges and Opportunities for Ship Recycling Industry in India, Journal of the Indian Ocean Region, 20 (1), 37-53, 2024

[7] Y. S. Narayan and J. S. S. R. Krishnan Ship Recycling: A Handbook for Professionals, Wiley,2018, p.

[8] G. J. A. F. Khan, M. H. Rahman, and S. M. I. Hossain, Recovery of Valuable Materials from Ship Breaking: A Review, Resources, Conservation and Recycling,100(1), 105-119,2015

[9] Ships are largely made of steel, one of the most recycled materials in the world. Once ships are decommissioned, ship breaking provides an opportunity to recover large quantities of steel, which can be reused in the construction of valuable electronics and machinery parts can be recovered during ship breaking. This helps reduce the demand for virgin resources and supports a circular economy. The materials recovered from the decommissioned ships are reused or recycled for further use which involves establishment of related businesses, investment,

For example, recycling steel uses approximately 60-74% less energy than producing new steel from iron ore. This results in energy savings and a reduction in carbon emissions associated with mining and production processes.

**a) Safe Disposal of Ships**

Ships, particularly large commercial vessels, have a limited lifespan. As ships age, they become less efficient, unsafe, and unprofitable to operate. Ship breaking offers an environmentally responsible way to dispose of these end-of-life vessels. Without proper recycling, old ships would either remain idle, taking up valuable space in harbours, or be abandoned at sea, posing serious environmental and safety risks. Proper ship breaking ensures that vessels are safely decommissioned and the hazardous materials they contain are managed properly[10].

**b) Regulatory Compliance:**

International conventions and national laws, such as the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC) and the European Union Ship Recycling Regulation (EU SRR), mandate that ships must be recycled in a safe and environmentally sound manner. Ship-breaking yards that adhere to these regulations help ensure that the hazardous materials on ships (e.g., asbestos, lead, PCBs) are disposed of safely, reducing the risk of environmental contamination. new ships or in other industries like automotive, construction, and infrastructure. In addition to steel, ships contain valuable non-ferrous metals, such as copper, aluminium, zinc, and lead. These metals are in high demand and can be recycled for use in a variety of industries, reducing the need to mine new raw materials.

**c) Job Creation and Economic Development:**

*i) Employment Opportunities*

The ship breaking industry provides direct employment to hundreds of thousands of workers globally, especially in countries with large ship breaking yards, such as India (Alang), Bangladesh (Chittagong), and Pakistan. Jobs in ship-breaking yards range from manual labor (e.g., dismantling ship parts) to administrative and logistical roles. In addition to direct

infrastructure, and creation of employment opportunities. Recycling of the dismantled ships is the best example of circular economy. Recycling ship materials saves significant amounts of energy compared to extracting and processing raw materials

[10] Jugović, A., Kolar, M., & Vuk, M, "Ship Demolition Activity: A Monetary Flow Process Approach" Journal of Maritime Studies, Volume 29, Issue 2, Pages 133-144, Year 2015

employment, the ship breaking industry creates indirect job opportunities in sectors such as waste management, transportation, machinery operation, and material recycling.[11]

*ii) Local Economic Growth*

Ship breaking is a major industry in several developing countries and contributes significantly to their local economies. The industry generates revenue from the sale of recovered materials, which supports local businesses and infrastructure development. It also attracts investment in supporting industries, such as transport, engineering, and supply chain management, contributing to regional economic development.

**Reduction in the Environmental Impact of Ship Disposal**

**a) Prevention of Marine Pollution**

Ships that are abandoned or improperly disposed of can lead to significant environmental hazards. For example, ships that sink or are left to decay at sea can leak oil, hazardous chemicals, and other pollutants into the ocean. Ship breaking, when done responsibly, prevents this kind of marine pollution by ensuring that vessels are dismantled in controlled environments. In addition to removing hazardous substances, ship-breaking yards ensure that parts of the ship, such as batteries, paints, and fuel tanks, are handled and disposed of properly to prevent further contamination.

**b) Hazardous Material Management**

Ships often contain hazardous materials like asbestos, heavy metals, and toxic paints. Without proper ship breaking, these materials could pose severe risks to human health and the environment. Ship breaking yards specialize in safely handling and disposing of these materials, either by neutralizing them or recycling them in compliance with regulations. The need for responsible ship breaking lies in ensuring these dangerous substances do not find their way into the environment, where they can harm ecosystems and human populations.[12]

**Reduction of Ship Traffic and Maritime Safety**

**a) Decommissioning Old Vessels**

[11] Damien Devault, Briac Beilvert, and Peter Winterton "Ship breaking or scuttling? A review of environmental, economic and forensic issues for decision support" journal Environmental Science and Pollution Research, Volume 23, Issue 24, 24685-24697 in 2016

[12] M. S. Johnson, T. R. Barr, Shipbreaking and Global Supply Chains: The Challenges of Hazardous Waste Management, Global Environmental Change, 62, 2020.

By decommissioning and recycling older ships, ship breaking reduces the number of potentially unsafe vessels operating on the seas, which improves overall maritime safety.

**b) Promoting a Cleaner and More Sustainable Maritime Industry**

With ships decommissioned and recycled responsibly, the shipping industry as a whole can operate in a more environmentally responsible manner. The ship breaking industry is integral in closing the loop of the circular economy, ensuring that valuable materials are recovered, reused, and recycled, reducing the demand for new raw materials and lowering the industry's overall environmental impact.

## CONTRIBUTION OF SHIP BREAKING TO CIRCULAR ECONOMY

**a) Sustainability and Resource Efficiency**

Ship breaking aligns with the principles of the circular economy, which seeks to minimize waste and make the most out of existing resources. Rather than relying on the extraction of new raw materials, the ship breaking industry recycles materials from decommissioned vessels, helping to reduce environmental degradation caused by mining and manufacturing new goods. This process conserves valuable resources like steel, aluminium, copper, and other metals, which are used in various industries such as construction, automotive manufacturing, and electronics[13].

**b) Green Ship Recycling**

The shift toward green ship recycling involves adopting sustainable practices to reduce the environmental impact of ship breaking. These include the use of cleaner technologies, improved waste management systems, and the safe removal of hazardous materials. This trend is gaining traction due to international regulations and growing awareness of environmental sustainability, further reinforcing the need for responsible ship breaking. [14]

Global Shipping - Industry's Need for Sustainable Practices

[13] M. C. G. de Lima, F. D. M. P. Chaves, Environmental and Social Impacts of Shipbreaking in the Context of Circular Economy, Marine Pollution Bulletin, 92, 147-154, 2015.
[14] J. W. Lee, H. K. Kim, S. C. Choi, Green Ship Recycling: A Study on the Ship Recycling Regulation and Its Implementation, Journal of Environmental Management, 133, 330-337, 2014.

As the global shipping industry grows, so too does the number of ships reach the end of their operational lives. The need for responsible ship breaking practices to handle the disposal of these ships is critical, especially as environmental regulations become more stringent.

## ALTERNATIVES TO SHIP BREAKING

Decommissioned ships can be repurposed for a wide variety of alternative uses without the need to break them down. These creative alternatives not only extend the life of the ship but also contribute positively to various industries and communities as a part of circular economy.

### a) Floating Hotels or Resorts

Decommissioned ships can be converted into luxury floating hotels or resorts, offering unique vacation experiences. These ships can be moored in calm waters and equipped with amenities like restaurants, spas, and entertainment facilities. This is an eco-friendly option, as it gives the ship a second life instead of being dismantled.[15]

Office Spaces or Business Venues Decommissioned ships can be repurposed as office spaces or co-working hubs. Their unique and spacious layouts make them ideal for housing creative teams, startups, or tech companies.

Further, ships can be transformed into event venues for conferences, weddings, concerts, or other large-scale gatherings. The novelty of hosting events on a ship adds a unique element for attendees.[16]For instance, The S.S. Rotterdam (Rotterdam, Netherlands), The MS St. Louis

(Hamburg, Germany).

### b) Maritime Museums and Educational Facilities

Some ships, especially those with historical significance, can be preserved as museum exhibits. These ships can be open to the public for tours and educational purposes, allowing visitors to explore maritime history. Further, decommissioned ships can be used by maritime academies or naval institutions for training purposes. Aspiring sailors or marine engineers can use these ships for hands-on learning about ship operations, safety drills, and maintenance. For example, The

### c) Artificial Reefs and Marine Habitats:

[15] Queen Mary 2 (Long Beach, California), The USS Lexington (Corpus Christi, Texas).
[16] The Floating Venice (Venice, Italy), Barge Housing Project (Amsterdam, Netherlands).

Ships can be intentionally sunk in designated areas to create artificial reefs. Over time, these ships become habitats for marine life, encouraging biodiversity and supporting local fishing industries. Further, decommissioned ships can also be used in marine conservation projects, acting as part of habitat restoration efforts for endangered species.[17]

**Floating Communities or Residential Housing**

In areas where land is scarce, decommissioned ships can be converted into floating homes or communities. These ships can be fitted with living spaces, communal areas, and amenities, offering an alternative way of living on the water. Further, floating ships could also be used as affordable housing solutions for low-income or displaced individuals, particularly in areas where housing demand exceeds supply

**Research and Observation Platforms**

Decommissioned ships can be converted into mobile research stations. Scientists can use them for oceanographic research, environmental monitoring, or wildlife observation. Ships can be equipped with labs, observation decks, and other facilities for marine research. These ships can be used to monitor environmental conditions such as water quality, marine pollution, and coastal ecosystems, playing a role in scientific data collection. [18]

**d) Cultural or Art Spaces**

A ship can be transformed into a traveling art gallery or exhibition space. Artists can use the unique environment of a ship to display their work, while the ship itself serves as a work of art. The ship can be repurposed to host cultural events, such as theatre performances, concerts, or film screenings. It could also serve as a hub for performing arts or community gatherings. [19]

**Emergency Relief and Disaster Response**

Decommissioned ships can be transformed into mobile hospitals or medical facilities, especially in areas affected by natural disasters. These ships can provide temporary healthcare infrastructure in remote or disaster-stricken areas. Ships can be outfitted to serve as storage facilities for emergency supplies or as command centres for disaster relief efforts. Their mobility allows them to reach areas in need quickly.[20]

[17] USS Oriskany (Florida, USA), HMAS Brisbane (Queensland, Australia).
[18] RV Atlantis (USA), The Oceanic Research Vessel (ORV) Sikuliaq (Alaska, USA).
[19] The Floating Art Center (London, UK), The Art ship (San Francisco, USA).
[20] The USNS Mercy (Global), The Logos Hope (Global).

**e) Transporting Cargo or Goods:**

Decommissioned ships that are still seaworthy can be repurposed to transport goods or materials in a cost-effective manner. They can be used for bulk storage or short-distance transport of various goods, particularly in regions with limited port infrastructure. Some older cruise ships can be converted to cargo vessels for transporting goods, particularly in areas where traditional cargo shipping options are limited or expensive. [21]

**Entertainment or Leisure Facilities**

A decommissioned cruise ship could be repurposed as a floating casino, attracting visitors and generating revenue for the local economy. It can offer gambling, entertainment, and dining experiences in a unique setting. Ships can be transformed into themed parks or interactive experiences, offering visitors a chance to experience something novel while enjoying various activities on board. [22]

**Storage or Warehousing:**

Decommissioned ships can serve as large-scale mobile storage units, particularly in areas where land-based storage options are limited or expensive. These ships can store goods, equipment, or even vehicles. In coastal areas, ships can be used as floating warehouses to store supplies, materials, or inventory, especially for industries reliant on port access. For example, The Queen Elizabeth 2 (Dubai, UAE), MV Laila (Bangladesh)

These alternative uses not only help reduce waste but also breathe new life into decommissioned ships, allowing them to serve various industries, create jobs, and provide unique experiences.

## KEY PRINCIPLES OF CIRCULAR ECONOMY IN SHIP RECYCLING:

1. Design for Disassembly: Ship designs are modified so that components can be easily removed, recycled, or reused at the end of the ship's life. This involves the use of materials that are easy to separate, re use, or recycle, like modular construction.

2. Resource Recovery: The aim is to recover as much material as possible from old ships. This includes metals like steel, copper, aluminium, and other valuable materials like plastics, glass, and rubber, which can be processed and reused in new industries.

[21] The RMS St. Helena (South Atlantic Ocean), SS President Wilson (USA).
[22] For instance, The Casino Ship MS Monarch (USA), The Floating Music Venue (Berlin, Germany).

3. Waste Reduction: The circular economy model reduces waste by ensuring that fewer materials end up in landfills. Materials from decommissioned ships are processed and reused, minimizing the disposal of hazardous materials.

4. Sustainability: By extending the lifespan of materials, ship recycling contributes to a more sustainable marine industry. It reduces the environmental footprint of new ship construction by minimizing the need for raw material extraction and transportation.

5. Innovative Recycling Technologies: Advanced technologies are being adopted to improve the efficiency and safety of the recycling process. These include automated sorting systems, advanced shredding technologies, and green energy solutions to minimize the carbon footprint of recycling operations. [23]

## CONCLUSION AND SUGGESTIONS

Circular economy is the need of the hour for controlling pollution from waste and creating wealth from waste, providing employment. Sustainable development and growth can be achieved through reusing and recycling waste.

For a better achievement of the circular economy, a few suggestions are made:

1. Governments and NGOs should bring awareness among different stakeholders of society about the reuse and recycling of waste.

2. Governments should make provisions in the law about reusing old vehicles by modifying them with new technology.

3. Educational institutions should have special programs for thought-provoking new ideas and incubation centres. Prizes and awards to be given for the best ideas to encourage young minds.

4. Banks and financial institutions should come forward to assist recycling units.

5. Governments should encourage recycling units by giving subsidies on power, loans, hassle-free permissions, etc.

6. Incentives to be given to industries for saving natural resources by using old materials.

[23] S. M. Geissdoerfer, P. Savaget, N. Bocken, E. Hultink, The Circular Economy: A New Sustainability Paradigm, Journal of Cleaner Production, 143(1), 757-768, 2021.