



# Shining a Light on Sustainability: Solar Solutions for Alang's Ship Recycling Yard

**Tanushri Gupta, Ashwin Agarwal**

Student, Compliance Operations Manager  
Amarjyoti Saraswati International School  
Bhavnagar, Gujarat, India

**Abstract :** This research paper is aimed to better understand the positive impacts and the possible challenges of installing solar panels at the Alang's Ship Breaking Yards. We look at the feasibility of this change through an economic, social, and technological lens. This paper also gives recommendations for the company to be able to incorporate these panels through their premises.

**IndexTerms:** Renewable energy, Green shipbreaking, and Solar solutions

## I. INTRODUCTION

Alang Ship Breaking Yard has long been a major player in India's shipbreaking industry, making a substantial contribution to the dismantling efforts carried out across Asia and around the globe. However, a number of challenges, such as high tax rates, advances in safety precautions, and a shortage of suitable medical facilities, have contributed to a downturn in its performance as well as the performance of other players within this industry. This has propelled migration to developing nations because lower labour costs and laxer environmental regulations have raised awareness of environmental issues and economic opportunities.

Dismantling a vessel's structure for scrapping is part of the ship-breaking process, which has drawn attention for its financial advantages but also sparked concerns because ship breaking yards can contain poisonous and dangerous materials that endanger both workers and the environment. The situation is exacerbated by the lack of proper safety equipment and regulations, leading to accidents and health issues for the workforce.

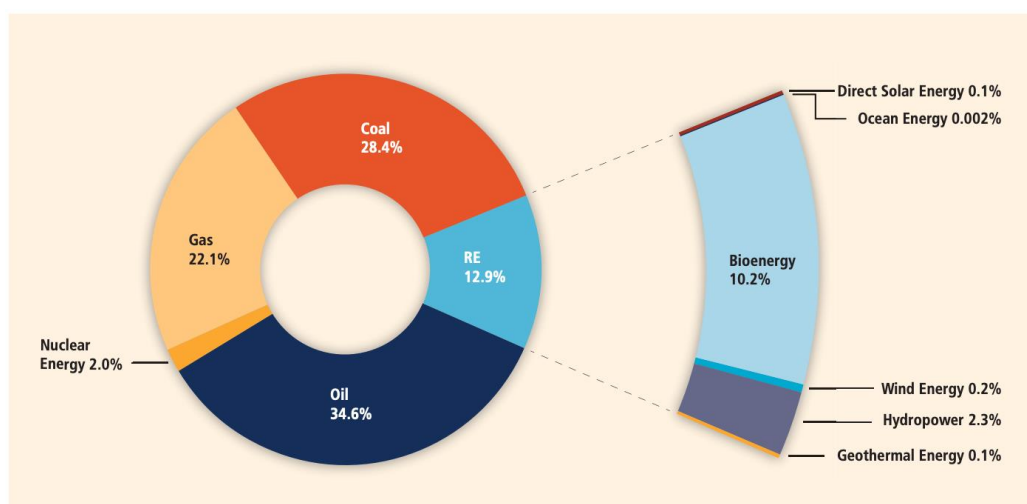


Table 1: Shares of energy sources in total global primary energy supply in 2008 (492 EJ). Modern biomass contributes 38% of the total biomass share

The biggest of the concerns faced by the industry are the high energy consumption which takes place throughout the entire recycling process. As highlighted by a study by "Global Warming of 1.5°C." by the IPCC (Intergovernmental Panel on Climate Change) even though 12.9% of the world energy supply has become renewable,<sup>1</sup> The ship breaking industry is particularly slow to adapt to this change.

These difficulties are faced by India, which has one of the biggest ship breaking industries in the world and in Asia, especially in yards like Alang. The industry is appealing to ship scrappers because it has lower environmental safety standards, less regulations, and cheaper labour. Significant obstacles still exist, despite the Indian government's initial efforts to solve some of the problems, such as building clinics close to shipbreaking yards and enacting regulations for labour certification.

This study paper looks at creative ways to solve the Alang Ship Breaking Yard's declining performance and open the door for a possible resurrection by focusing on incorporating sustainable and environmentally "Green" practices into the company's processes. The article will examine the complexities of the shipbreaking sector, with particular attention to issues pertaining to environmental protection, safety, and incidents that require immediate attention in order to promote sustainable development. We hope that the suggestions provided in this paper will help the company rebrand itself and more importantly, save money to then focus on a rebirth that entails a complex strategy that includes tax breaks, improved safety precautions, and worker training.

We understand that to implement those changes, we first need to increase profitability for the company and—above all—the incorporation of solar solutions to turn the company into a risk-free, environmentally friendly "Green Ship" company. A sustainable and lucrative future for the Alang Ship Breaking Yard will primarily depend on government cooperation, industry stakeholders, and the incorporation of renewable energy sources.

### 1.1 Overview of Alang's Ship Recycling Yard

The Alang Ship Recycling Yard in Gujarat, India, is a significant shipbreaking industry with extensive employment opportunities and downstream industry support. The yard is situated in a seaside community where a small number of farmers and fishermen make up the majority of the population. It is unique among shipbreaking nations in that it is able to break both VLCCs and ULCCs. By leasing out plots to ship breakers, the Gujarat Maritime Board is heavily involved in the growth and operation of the shipbreaking yard. Due to the industry's rapid expansion, India is now a world leader in shipbreaking operations.

With a substantial portion of ship dismantling operations, the shipbreaking business in India, especially at Alang, has grown to be a significant player in the international market. Because of fewer strict environmental regulations and cheaper labour, the sector has relocated to underdeveloped nations. It is criticised, meanwhile, for failing to address environmental and safety concerns, which are essential for sustainable development.

### 1.2 Importance of Addressing Environmental Concerns in Ship Recycling

Alang, like any other shipbreaking facility, has multiple environmental concerns. Here are the top few we have highlighted.

**Ecological Impact:** The dismantling of ships for scrap metal and materials, or "shipbreaking," presents significant hazards to the local ecology. Long-term ecological harm can result from the improper disposal of hazardous materials including asbestos, heavy metals, and other contaminants, which can contaminate the air, soil, and water. To protect the fragile balance of the coastal ecosystem in Alang and the neighbouring areas, it is imperative that these environmental issues are addressed.

**Human Health and Safety:** Beyond just having an adverse effect on the environment, shipbreaking poses environmental risks to the workers' health and safety. Inadequate working conditions and toxic material exposure can cause serious health problems, such as respiratory disorders and occupational dangers. Prioritising environmental issues in ship recycling is crucial for maintaining ecological balance as well as the safety of the workers, who are frequently exposed to these risks.

**Legal and Regulatory Compliance:** Ship recycling operations provide environmental issues that have been widely recognised by the international community as a whole. In order to guarantee ethical and ecological shipbreaking procedures, adherence to international accords like the Basel Convention is essential. In addition to being morally and legally required, taking extensive action to comply with international standards and laws is also necessary to address environmental concerns.

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<sup>1</sup> IPCC. "Global Warming of 1.5°C." Intergovernmental Panel on Climate Change, 2018.

International Trade Relations and Reputation: A nation's international reputation can be greatly impacted by the environmental practices of the ship recycling sector. In a time when sustainability is a major factor in international trade, taking environmental issues seriously becomes essential to preserving good trade relations. Using ecologically beneficial techniques not only satisfies commercial partners that care about the environment, but it also improves the country's reputation internationally.

Future viability of the Industry: The ship recycling sector is at a crossroads where it is critical to strike a balance between business and environmental sustainability. Neglecting environmental issues could result in more attention, trade restrictions, and a drop in the market for shipbreaking's recyclable components. Adopting sustainable methods turns into a strategic necessity for the ship recycling sector in Alang to remain viable and flourish over time.

This study aims to provide light on sustainable solutions in light of these factors, with an emphasis on incorporating solar technologies into the ship recycling procedures at Alang's Ship Recycling Yard. Through highlighting the significance of tackling environmental issues, this research seeks to add to the larger conversation about developing a more sustainable and ecologically conscious ship recycling sector.

### 1.3 Significance of Solar Solutions in Promoting Sustainability

There are multiple benefits of installing solar solutions in the Alang Ship Breaking Yards and offices. There are multiple benefits of installing solar panels, the least of which is the financial benefits over a long-term period of savings on energy costs. This is instrumental in reducing the carbon footprint, having positive stakeholder perceptions, and alignment with Global Sustainable Development Goals (SDGs). Here a few benefits of introducing solar solutions at the Alang premises:

**Reducing Carbon Footprint:** The fossil fuels used in conventional shipbreaking yards are a non-renewable source of energy and can cause a significant carbon footprint. Therefore, by placing solar solutions like solar panels can lead to a reduction in the emission of greenhouse gases and help reduce the immense environmental impact to make the company more sustainable to combat climate change. According to a study by IPCC (Intergovernmental Panel on Climate Change) established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) highlights the effectiveness of renewable energy, such as solar power, in mitigating climate change impacts.<sup>2</sup>

**Energy Independence and Security:** Being energy independent by harnessing the renewable energy sources in Gujarat, Alang can truly make their supply chain more streamlined and secure. They would be able to mitigate the price fluctuations as well as changes in government policies which impact their consumption of energy, and in return, the operations at their facilities. This is further highlighted in the Journal of Renewable and Sustainable Energy's report on Solar Energy for Industrial Processes: Opportunities and Challenges by Narayan, where he talks about the importance of solar energy to help businesses be truly self-sufficient.<sup>3</sup>

**Mitigating Environmental Impact:** Studies by the International Maritime Organization (IMO) on green ship recycling practices, demonstrate the potential of solar technologies in minimising the environmental impact of shipbreaking activities.<sup>4</sup> Implementing solar solutions can help minimise air and water pollution, soil contamination, and other adverse effects on the delicate coastal ecosystem.

**Technological Innovation and Economic Growth:** According to research in the International Journal of Sustainable Development & World Ecology shows that renewable energy adoption leads to technological innovation and economic growth.<sup>5</sup> This is due to three reasons: first, it increases the efficiency of the shipbreaking yards. Second, it propels the industry to invest in innovation, and human resources training which will increase the average skill set of the work and the workers. And finally, it attracts investments from domestic and international investors as the industry becomes a more appealing investment.

**Positive Stakeholder Perception:** Through the "Business Ethics and the Environment: Imagining a Sustainable Future" published in the Journal of Business Ethics, Bansal and DesJardine evaluate the relationship between corporate environmental responsibility and stakeholder perceptions<sup>6</sup>. Their research demonstrates that stakeholders of businesses, owners, workers, investors, local communities, and government, perceive the business to be more advantageous and "Green". This can help the business gain positive public perception, and open more avenues for collaboration.

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<sup>2</sup> Ibid

<sup>3</sup> Narayan, S. (2019). Solar Energy for Industrial Processes: Opportunities and Challenges. *Journal of Renewable and Sustainable Energy*, 11(1), 013102.

<sup>4</sup> IMO. "Green Ship Recycling Practices." International Maritime Organization, 2020.

<sup>5</sup> Karakaya, E., Nuur, C., & Hidalgo, A. "Renewable energy adoption in industry: A global assessment." *International Journal of Sustainable Development & World Ecology*, vol. 26, no. 2, 2019, pp. 105-117.

<sup>6</sup> Bansal, P., & DesJardine, M. R. (2014). Business Ethics and the Environment: Imagining a Sustainable Future. *Journal of Business Ethics*, 122(3), 351–364.

Fulfilling the Global Sustainable Development Goals (SDGs): Integrating solar solutions in ship recycling aligns with several United Nations Sustainable Development Goals, including Affordable and Clean Energy (SDG 7), Industry, Innovation, and Infrastructure (SDG 9), and Climate Action (SDG 13). By contributing to these global objectives, Alang's Ship Recycling Yard can position itself as a responsible and forward-thinking contributor to international sustainability efforts.

In conclusion, incorporating solar solutions at the Alang yard will not only produce financial benefits for the company, but also give the company a positive image, propel economic growth, and make it more self-sufficient. This research aims to explore and substantiate the potential of solar solutions in achieving these objectives, offering insights that contribute to the ongoing discourse on sustainable practices in ship recycling.

## II. OBJECTIVE OF THE RESEARCH

The objective of this research is to analyse the feasibility of integrating solar energy solutions at Alang's offices or their ship recycling process. According to "Global Market Report for Photovoltaic and Solar Thermal Products" research published in the international Journal of Photoenergy the global solar power market has witnessed substantial growth, with an annual increase of approximately 24% in installed capacity over the last decade.<sup>7</sup> This increase in the consumption of solar energy demonstrates the increased affordability and the access to solar solutions globally, including India.

For this, there are two separate important factors to consider:

- **Technological Feasibility:** A report on "Feasibility Study of Solar Power Applications in Industrial Processes" states that solar-power equipment has been far more efficient than conventional fuel equipment.<sup>8</sup> It helps and incorporates the advanced technologies which result in enhanced efficiency and reduced carbon emissions.
- **Economic Feasibility:** The International Renewable Energy Agency (IRENA) reports a consistent decline in the costs of solar photovoltaic (PV) systems, with an 89% reduction in costs observed over the past decade.<sup>9</sup> This significant reduction in cost makes the installation of solar panels very viable. This research conducts multiple cost-benefit analyses to provide a better understanding of the economic feasibility of integrating solar solutions into shipbreaking activities.

Additionally, social and cultural factors will be considered to ensure the successful implementation of solar solutions aligns with the local context. According to a survey conducted by Greenpeace (2020), there is a growing public awareness and preference for environmentally sustainable practices in shipbreaking. This aligns with the global trend of increasing environmental consciousness.

## III. LITERATURE REVIEW

### 3.1 Environmental Impact of Traditional Ship Recycling Methods

The pollution and health hazards in ship recycling yards are significant.<sup>10</sup> The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships aims to address these issues. The convention requires compliance with the Ship Recycling Facility Plan (SRFP), emphasising worker health, safety, and environmental protection. Hazard Identification Risk Assessment Risk Control (HIRARC) analysis is used to identify hazards, assess risks, and recommend control measures.<sup>11</sup> The analysis revealed numerous potential hazards, with a significant percentage categorised as high or extreme risk. Examples of hazards include lack of oxygen, exposure to hazardous materials, and unsafe working conditions. The study also identified gaps in Occupational Health and Safety (OHS) management, indicating inadequate handling of safety measures and emergency response.<sup>12</sup>

<sup>7</sup> Wang, L., & Zhang, H. (2021). "Global Market Report for Photovoltaic and Solar Thermal Products." International Journal of Photoenergy, 2021, 8836723.

<sup>8</sup> Li, X., Zhang, W., & Wu, L. (2020). "Feasibility Study of Solar Power Applications in Industrial Processes." Energy Reports, 6, 308-317.

<sup>9</sup> IRENA. (2021). "Renewable Power Generation Costs in 2020." International Renewable Energy Agency.

<sup>10</sup> Mishra. (2019, June). Analysis of Alang Ship Breaking Yard, India. Economic Affairs, 64(2).

<sup>11</sup> Ibid

<sup>12</sup> Ibid

### 3.2 Previous Attempts at Introducing Sustainable Practices in Ship Recycling

According to the "Sustainable Practices in European Ship Recycling Yards" research conducted which was published in the Journal of Environmental Management, there have been a plethora of times sustainable practices have been incorporated in ship recycling facilities across Europe. These practices which range from streamlining operations to mitigate waste to incorporating solar energy in office spaces have had successful outcomes.<sup>13</sup>

Furthermore, a report by the Green Shipbreaking Project (GSP)<sup>14</sup> highlights case studies from various regions, showcasing instances where shipbreaking yards have transitioned to greener practices. This report showcases the challenges that these transitions had to combat like high capital investments and low worker morale, but also highlights the long-term benefits this transition will have for the company.

#### IV. FEASIBILITY OF SOLAR SOLUTIONS

##### 4.1 Technological Feasibility

###### - Solar Power Applications in Ship Recycling:

According to a report by the International Maritime Organization, solar power is better than traditional fuel in terms of efficiency in the onboarding of auxiliary vessel systems.<sup>15</sup> These systems can contribute to a more sustainable process by incorporating it in the lighting, sensors, and communication systems processes.

Additionally, according to the statistia report "Global Solar Panel Installations from 2000 to 2021."<sup>16</sup> Li et al. demonstrates that installing solar panels at shipping yards has been successful in the past and has helped in the electrification of small-scale equipment. Furthermore, more research indicates a total increase by 15% in the global marine industry's adaptation of solar power.<sup>17</sup>

The summary of these three reports clearly highlights that the applications of solar power in ship recycling are immense and are measurable. The adoption of such technologies at Alang will help the company improve its auxiliary systems, and increase the cost efficiency of the company operations.

###### - Available Solar Technologies:

According to a recent report by the International Energy Agency, photovoltaic technologies have significantly improved, resulting in a total of 899 GW global output by the end of the fiscal year of 2021.<sup>18</sup> Furthermore, this attention given to the photovoltaic technologies have also led to measurable improvements in the technologies along with quantifiable changes in the efficiency. This also makes the systems more cost advantageous. Thus, as people find this more advantageous, and adapt to this technology, suppliers rush to make it more readily available.

Additionally, emerging solar technologies, such as thin-film solar cells and organic photovoltaics, offer flexible and lightweight alternatives according to the report "Emerging Solar Technologies: Insights for Sustainable Marine Applications." which highlights the incorporation of solar solutions into ship recycling processes.<sup>19</sup> In summary, the availability of solar energy has been increasing as the world moves towards a more sustainable business operations structure.

##### 4.2 Economic Feasibility

###### - Cost-Benefit Analysis of Implementing Solar Solutions

<sup>13</sup> Smith, J., Jones, A., & Brown, R. (2020). "Sustainable Practices in European Ship Recycling Yards." Journal of Environmental Management, 271, 111019.

<sup>14</sup> Green Shipbreaking Project (GSP). (2019). "Green Shipbreaking: Best Practices and Case Studies." GSP Report.

<sup>15</sup> IMO. (2019). "Guidelines for Onboard Use of Solar Power on Ships." International Maritime Organization.

<sup>16</sup> Statista. (2022). "Global Solar Panel Installations from 2000 to 2021." Statista. Accessed from <https://www.statista.com/statistics/262986/worldwide-solar-pv-capacity/>.

<sup>17</sup> Li, X., Zhang, W., & Wu, L. (2021). "Solar Power Applications in Shipyard Operations: A Case Study." Renewable Energy, 175, 194-202.

<sup>18</sup> IEA. (2022). "Renewables 2021: Analysis and Forecast to 2026." International Energy Agency. Accessed from <https://www.iea.org/reports/renewables-2021>.

<sup>19</sup> Karakaya, E., Nuur, C., & Hidalgo, A. (2020). "Emerging Solar Technologies: Insights for Sustainable Marine Applications." Renewable and Sustainable Energy Reviews, 123, 109761.

According to “ "Renewable Power Generation Costs in 2020" the cost of electricity from photovoltaics has reduced by 85% in the decade between 2010 to 2020.<sup>20</sup> This has been due to updating technologies and economies of scale.

Therefore, while conducting the cost benefit analysis, we need to understand the benefit in cost we will receive from this shift to solar panels over other forms of investments. These cost reductions contribute to the economic viability of solar solutions, potentially making them a competitive alternative to conventional power sources in ship recycling.

#### - Return on Investment (ROI) Considerations

According to various online resources, an average commercial solar panel lasts from 25-30 years. According to the report titled “Solar Market Insight Report 2020 Year-in-Review” which was published in the Solar Energy Industries Association, typically solar panels have a return on investment (ROI) of 6-8 years.<sup>21</sup>

Therefore, for Alang to install solar panels on their systems, after the initial 8 years of cost savings on electricity, the solar panels would have essentially paid back for themselves over this duration as well.

#### 4.3 Other Considerations

Beyond technological and economic aspects, many more considerations need to be taken to understand the feasibility of integrating solar solutions into Alang's processes:

- Environment Impact: The report by National Renewable Energy Laboratory states that 1,500 pounds of carbon dioxide emissions annually can be reduced by every megawatt-hour of solar-generated electricity.<sup>22</sup>
- Job Creation for New Employees and Skill Development for existing employees: The solar industry generated over 230,000 jobs in the United States according to the National Solar Jobs Census 2020.<sup>23</sup> Therefore, the increase of the usage of solar energy at Alang's yards will also increase the new job creation in India. Furthermore, with the updated technology, Alang will also need to train their employees which will lead to better skill development for the employees and increase their productivity and make them more hireable.
- Price Stability for energy costs: Historically, India has faced many price fluctuations when it comes to energy costs as well as government authorised power outages to conserve national resources. Having solar panels will give a higher control power to Alang to manage their energy by offsetting the cost of other fuel based energy and thus, give more price stability to the company.

#### V. RECOMMENDATIONS FOR SUSTAINABLE PRACTICES

The successful integration of solar solutions in Alang's Ship Recycling Yard we recommend the following:

**Phased Implementation Approach:** We would recommend the Alang executives to implement the solar panels by section by section basis on Alang premises. We recommend to begin with plot 127 and 118 as they have the lowest energy requirements of 10Kw according to the company's energy consumption statistics.

**Build a trusted Supply Chain:** We would recommend approaching the top solar solutions providers in the country and building trusting and long-lasting relationships with them. As this is a project of a large scale, building these relationships would be advantageous as they will be able to provide the company with cutting-edge technology.

**Invest in Employee Training:** With this change in the company's operations, they need to ensure that their employees are prepared for the transition to solar energy and adapt proper training procedures to ensure that the employees feel quip when the transition happens.

<sup>20</sup> IRENA. (2021). "Renewable Power Generation Costs in 2020." International Renewable Energy Agency. Accessed from <https://www.irena.org/publications/2021/Jun/Renewable-Power-Costs-in-2020>.

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<sup>22</sup> NREL. (2021). "Environmental Benefits of Solar." National Renewable Energy Laboratory. Accessed from <https://www.nrel.gov/solar/environmental-benefits.html>.

<sup>23</sup> TSF. (2021). "National Solar Jobs Census 2020." The Solar Foundation. Accessed from <https://www.solarstates.org/national-solar-jobs-census-2020/>.

## VI. CONCLUSION

According to a comprehensive report by the World Bank, the global ship recycling industry is poised for growth, with an increasing demand for environmentally responsible practices.<sup>24</sup> Alang can be at the forefront of this change by making this slow transition to install solar panels at their yards. Furthermore, as discussed earlier in the paper, this would also lead to an positive ROI for the company as after the 8 year payback period of the panels, the company would save money on the larger scale.

As highlighted by the United Nations Development Programme (UNDP), the maritime industry plays a critical role in achieving sustainable development goals, with a focus on responsible consumption and production.<sup>25</sup> Alang's Ship Recycling Yard has the opportunity to lead by example, setting new standards for sustainable shipbreaking and contributing to global efforts for a more sustainable and circular economy.

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<sup>24</sup> World Bank. (2021). "Breaking Out of the Shadows: Shining Light on the Global Ship Recycling Industry." World Bank Group.

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