Green cruising: eco-friendly technologies on cruise ships

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Abstract: Cruise lines are believed to be the world's t worst polluters. Even though cruise ships represent only 1% of the global fleet, they have quite a big rate of black carbon emission according to the European Maritime Transport Report 2021. Besides CO_2 emissions there are lots of other pollutants like sewage water, gray water, oily bilge water, hazardous and bio-wastes that impact the environment heavily. To overcome the challenge and improve passengers' perception of the sector, the industry shifts the spotlight to responsible tourism and extensively invests in green technologies. The industry promises net zero carbon neutral cruising by 2050. However, some industry experts and NGOs still sound the alarm regarding not sufficient measures and activities to be taken to ensure eco-friendly tourism.

The paper aims at analyzing the progress made by cruise society regarding responsible tourism, namely the effectiveness of green technologies on cruise ships to assess the sufficiency of the current activities. The results of the research provide useful information on tracking the results of the implementation of the intended goals and benchmarking of cruising sustainable development.

Keywords: green cruising; sustainable technologies; eco-friendly technologies; cruise ships; efficiency assessment

1. Introduction

Global cruise industry- a giant, that has been growing rapidly for the third decade and notwithstanding the colossal damage caused by the Covid-19 disaster, stays the fastest-growing and the most profitable sector of the tourism industry in the world.

Cruise lines operate with fascinating figures, showing incredible financial turnover, employment rates, and statistics. According to CLIA 2019 Economic Impact Study (CLIA-

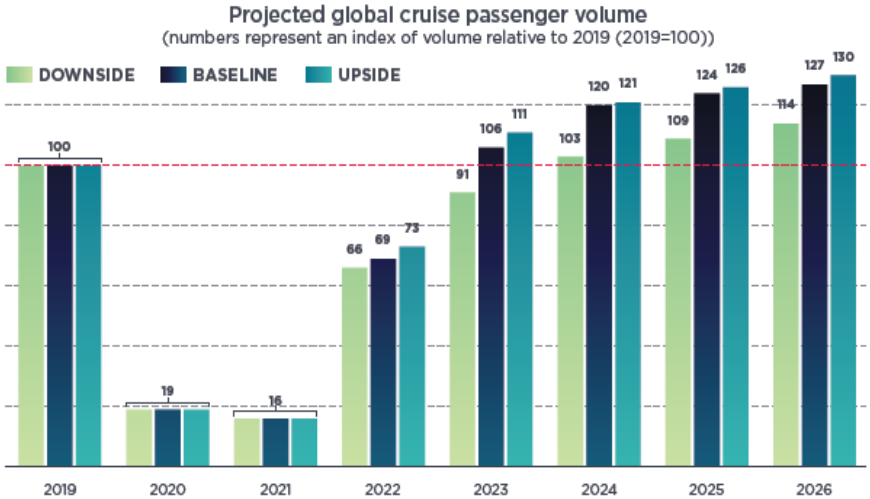

Figure 1. CLIA Cruise Forecast.
Source: Tourism Economics (December 2022)

Cruise Lines International Association- the largest cruise industry association and the leading

authority for the entire global cruise community), global cruising represents a $155B business with 1.2 million employees and $50B paid in wages. Although the 2021-2022 devastating pandemic has reduced several times the 2019's cruise numbers, for now, the cruise industry is recovering even faster than international tourism arrivals. The sector is moving closer to pre-pandemic levels. Moreover, CLIA expects the industry to overcome 2019's rates by 6% by the end of 2023, which makes 31.5 cruise passengers sailing worldwide. (Fig. 1) The sector is growing, and the cruise fleet does as well. According to the CLIA report, 272 ships were projected to be in operation in 2022. Despite all the positive tendencies, there is an opposite side of the matter that is called environmental impact.

A comfortable vacation in a "floating hotel" with all kinds of entertainment- sea travel on a cruise liner is just gaining popularity among tourists over the years. Meanwhile, environmentalists are sounding the alarm: they believe large cruise ships have already become one of the main sources of pollution today. A group of scientists from Spain, Croatia, and the UK conducted a study on the cruise ships industry, and as a result of which they called for limiting the cruise ship industry. Experts see the cruise industry as a danger to the environment. According to a study published in "Marine Pollution Bulletin" in 2021, the environmental and health impacts of the cruising industry are huge. For example, the carbon footprint of one large cruise ship exceeds the emissions of 12000 cars, and the waste produced by the ship is more than a ton per day [2].

According to Environment Journal, 46 cruise ships of Carnival Corporation & PLC in 2017 emitted almost 10 times more sulfur oxide (SO_x) into the atmosphere than all 260 million European cars. This conclusion is given in a study published on June 7, 2019 by the European Federation for Transport and the Environment (Transport & Environment Group). Among the countries most affected by sulfur oxide pollution are Spain, Italy and Greece, followed by France and Norway - those where sea cruises are most popular. According to the study [3], 203 cruise ships ply the waters around Europe, which make a significant contribution to the air pollution of coastal cities. In 2017, these 203 ships emitted 62,000 tons of sulfur oxide, 115,000 tons of nitrogen dioxide, 10,000 tons of particulate matter and more than 10 tons of carbon dioxide into the atmosphere.

2. The impact of cruise ships

In 2015 all the United Nations Member States adopted and set 17 Sustainable Development Goals (SDGs) to be reached by 2030. The goals are global and aim at promoting sustainable development worldwide across three basic dimensions: economic, social, and environmental. In the frames of the 2030 Agenda for Sustainable Development, the authorities of different countries are taking more and more stringent measures against non-environmental transport both on land and water. However, maritime transport remains to be comparatively less observed and partially out of the view of environmentalists. This is especially true for cruise ships, which often visit ports where cargo ships do not call. They sometimes moor right in the city, causing additional harm to the environment. According to the T&E report, shipping remains the least regulated transport sector, especially when it comes to sulfur emissions. Environmental standards for sulfur emissions for maritime transport are 100 times higher than those for cars with diesel and gasoline engines.

As per Marine Pollution Bulletin, the activity of cruise ships leads to the degradation of air, soil, water, entire ecosystems, as well as wildlife. Every day, ships throw out about 56 liters of hazardous chemical waste, and a person's carbon footprint is tripled. In addition, cruises greatly affect people's health. For example, in the UK, between 40,000 and 100,000 people die prematurely every year due to emissions from the cruise and shipping industry. Residents of large port cities are especially vulnerable.

According to the European Maritime Transport Environmental Report 2021, larger ships emit larger amounts of black carbon gases. Oil tankers, container ships, and bulk carriers make up 60% of all black carbon emissions. Notwithstanding the fact that cruise ships account for only 1 % of the global fleet, cruise ships make up 6 % of global black carbon gases, which makes a huge amount of emissions per vessel.

Besides the poisonous air pollution caused by ships functioning, which includes emissions of carbon monoxide, sulfur dioxide, nitrogen oxide/ dioxide, and other harmful hydrocarbons, there are lots of other pollutants and wastes that derive from cruise ship activities and processes aboard. Among the damages caused by cruise ships, there is the waste of sewage water. *Sewage* or blackwater is wastewater containing urine and fecal matter that

is generally disposed of directly into the open ocean. The sewage water represents a risk to human health as it can be contagious by transmitting dangerous bacteria to the seafood. Another wastewater that also gets into the ocean is *greywater.* Generated from non-industrial processes (drainage from laundry facilities, showers, bath, dishwasher drains, galley taps, etc.) it represents the largest amount of wastewaters produced by a cruise ship (more than 60%) and contains biological and chemical contaminants. One more source of liquid waste, gathered at the bottom of the cruise vessel and mixed with gasoline, metal shavings, oil, paint and other particles is called *oily bilge water.* The special equipment installed onboard the ship is supposed only to lessen the concentration of the amounts of this water draining out of the ship.

According to Nickie Butt cruise ships produce 25% of waste produced by merchant ships worldwide while representing only 1 % of it (Butt, 2007) [4]. Another statistics for cruise ship garbage management is following: "A medium-size cruise ship with 3,600 passengers can generate 2,358 m^3 of greywater and treated sewage, 84 m^3 of oily waste and 266 m^3 of solid waste weekly "(Kotrikla et al., 2021) [5].

It is difficult to determine the exact quantity of solid waste and garbage generated by the cruise ships globally, however the impact is quite heavy and depends on the policies and solid waste management protocols of the cruise companies and welcoming countries.

For now, cruises are a significant source of pollution and environmental degradation, and this industry should be under global control and effective legislation.

2. A model for responsible tourism

The negative environmental impact of the cruise industry is backed up with industry studies and statistical data. The fact is undeniable, yet unacceptable within the cruise community. While the green community and non-governmental organizations such as "Friends of the Earth", "World Resources Institute", "Global Footprint Network" and others clearly articulate their position towards "floating hotels" and publish evidences of environmental violations committed by the industry over the past 20 years, the cruise community firmly positions itself as a model for sustainable and responsible tourism. To

overcome the challenge and improve passengers' perception of the sector, the industry shifts the spotlight to responsible tourism and extensively invests in green technologies. In the 2021 report, Cruise Lines International Association (CLIA) declared a $23,5 billion investment in a cleaner future with new ships and sustainable development. According to 2023 CLIA State of the Industry Report there are some fundamental changes in the approach of tourism management. The innovations include proactive collaboration with port managements, local food sourcing and water repurposing/ conservation, as well as arrangement of *sustainable* onshore excursions. CLIA promises collaborations with marine life protection organizations to ensure noise reduction and wastewater treatment systems and devices onboard.

3. Going green: eco-friendly technologies

The cruise lines declare decarbonization by enhancement in technologies, operations and infrastructure, however, the claim sounds better than it actually is. Let's take a closer look at it.

For today LNG is considered to be the cleanest and most adoptable fuel available to cruise lines among the other marine fuels. Utilizing of LNG fuel compering to conventional ones reduces GHG by 20%, SO_x by 20%, black carbon particles -98% and NO_x by 85%. However, as of February 2023, there are only 21 LNG- powered cruise ship worldwide (11 active and 10 to be launched before long) that makes less than 15 % of the global capacity. [7] The 2022 CLIA report set ambitious goals: the industry promised net zero carbon neutral cruising by 2050, LNG-powered ships with wastewater treatment technologies, and exhaust gas cleaning systems as well by 2027.

The 2023 CLIA report declares:

- totally 38 LNG-powered ships to be functioning by 2028- yet only 11 is in operation;
- 75% cruise fleet to be able to consume sustainable fuels such as biofuels, synthetic fuels, hydrogen, methanol, batteries and others once available at scale- yet none is utilizing sustainable fuels;
- 60% of the ships to be fitted with shoreside power capabilities-yet only 30% do;

- 20 ports to be equipped with on-shore power by 2025 that makes 3% totally of the world's cruise ports- yet only 2 % is;
- New-build non-LNG cruise ships are equipped with (EGCS) Exhaust gas cleaning system, that makes 79% of global capacity (Fig. 2)- yet EGCS system is not considered sufficiently green and sustainable technology.

According to the Figure 2, the achievements shown in the 2023 CLIA Report are

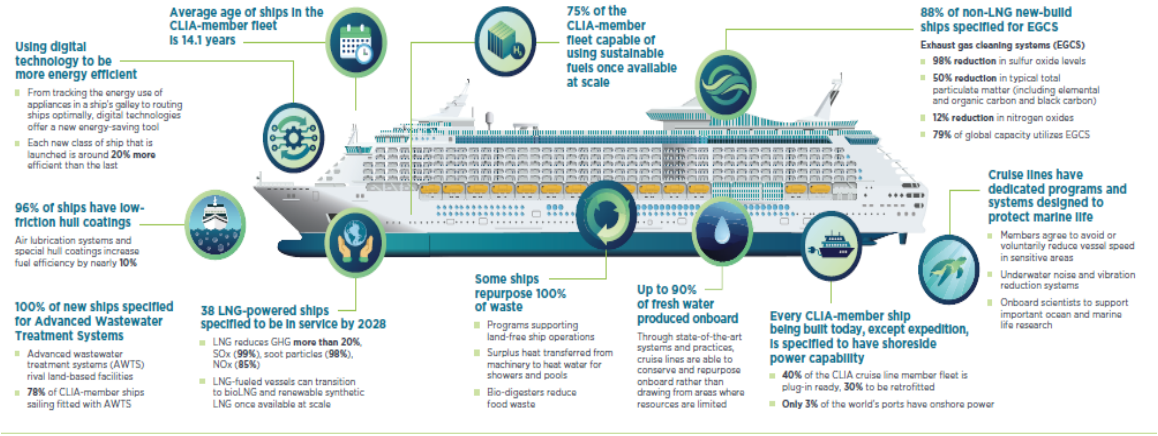

Figure 2. Responsible tourism approach onboard. Source: CLIA Environmental Technologies and Practices Report (October 2022)

impressive, however, the pace of the development and quality of implementation of sustainable technologies is not as encouraging as it might seem.

Some industry experts sound the alarm regarding not sufficient measures and activities taken to ensure eco-friendly tourism. When it comes to cruising, waste amount literally triples compared to onshore activities waste. Thus, going green means 3 times more diligence to protect the environment and provide responsible travel.

"Friends of the Earth" – the NGO that strives for a healthier and more sustainable world and evaluates cruise lines and ships for 13 years straight to answer one question: Is the green cruising possible or not? According to 2022 Cruise Ship Report card, where have been evaluated 18 major cruise lines across four environmental factors like *Water Quality Compliance*, *Sewage Treatment*, *Air Pollution Reduction* and *Transparency*- none of the evaluated cruise lines has received final grade "Excellent" (A) or "Good Performance"(B).[8]

4. Conclusion

The conducted desk research has shown that in the frames of global tendency of green technologies, environmental sustainability and announced 17 Sustainable Development Goals set by United Nations that are to be reached by 2030, cruise line managers are stuck in the strict frames and deadlines stated by global society. They are forced to meet the requirements of new standards and protocols, however the results are not sufficient.

The study has resulted in the following conclusions:

- From the perspective of scale, the environmental impact of cruise ships is underrated and has even more severe effects in the long term;
- Responsible cruise tourism onboard changes management system and enables effective approaches for intersectoral collaborations;
- Currently functioning and projected cruise ships with green technologies onboard don't provide enough sustainability to meet SDGs by 2030.

Conflict of Interest Statement

The authors certify that the manuscript has not been submitted to, nor is under review at any other journal or other publishing venue. The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript. There is no financial interest to report.

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