CRUISE ON VOYAGE TOWARDS DECARBONIZATION

Abstract

The cruise industry encompasses enterprises within the travel domain that arrange journeys aboard expansive vessels designed to accommodate a large number of passengers. It covers cruise lines, ship owners, and firms that build cruise ships. The cruise industry encompasses enterprises that specialize in providing ship entertainment services. Cruise lines provide a diverse range of cruise packages, including lodging, dining, and recreational activities. Several prominent cruise firms in the industry include Carnival Corporation, which encompasses several brands such as Princess Cruise lines, Costa Cruises, and Holland America Line. Over the course of time, the cruise sector has seen significant expansion, resulting in the generation of substantial income amounting to billions of dollars. Nevertheless, the sector saw a decline within the worldwide COVID-19 epidemic, which had a significant impact on both the tourist and international shipping industries. The worldwide market value of the cruise ship industry was recorded at $7.67 billion in 2022, with a projected growth rate of $15.1 billion by the year 2024 (CLIA, 2021). Nevertheless, this seemingly exhilarating expedition has a substantial impact on our natural surroundings. Cruise ships are renowned for their substantial size, ranking among the biggest vessels globally. Research has shown that a single cruise ship's carbon emissions are greater than those of almost 12,000 cars. In this chapter, alternative strategies to reduce carbon emissions by the cruise industry are discussed in detail, along with its resilience to thrive in a sustainable marine environment.

Keywords: Sustainability, Marine Ecosystem, Pollution, Carbon Emission, Green Fuel.

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I. INTRODUCTION

Cruise ships are expansive vessels mostly used for recreational purposes, accommodating a significant number of passengers. In contrast to ocean liners that primarily serve as transportation vessels, cruise ships often undertake circular journeys to many ports of call, offering passengers the opportunity to participate in guided tours referred to as "shore excursions. In 2021, the global cruise industry consisted of a total of 323 operational cruise ships with a collective passenger capacity of 581,200 people. Cruising has emerged as a significant component of the tourist sector, with an estimated market value of $29.4 billion per year. As of 2011, the global cruise business was responsible for transporting more than 19 million people on an annual basis. The business had significant expansion, with the addition of at least nine newly constructed ships every year since 2001, specifically targeting North American customers. Additionally, there were additional ships serving European customers until the COVID-19 pandemic in 2020, which resulted in a near-complete cessation of operations within the industry. The user's text is already academic and does not require any rewriting. As of 2023, the biggest cruise ship in terms of both size and passenger capacity is the Wonder of the Seas, owned by Royal Caribbean. This vessel has exceeded the dimensions of its predecessor, the Symphony of the Seas, and is expected to be eclipsed in size by its successor, the Icon of the Seas (Crockett, 2020; Cruise Industry News, 2020).

The initiation of passenger-cruising services by P&O occurred in 1844, when they started advertising sea tours to various places like Gibraltar, Malta, and Athens. These excursions were scheduled to depart from Southampton. The first ship dedicated only to providing luxurious cruising experiences was the Prinzessin Victoria Luise, commissioned by the German Empire and masterminded by Albert Ballin in 1900. Cruise ships are structured in a manner akin to drifting hotels, with a comprehensive hospitality team alongside the customary ship's personnel. It is not unusual for the most opulent vessels to possess a greater number of crew members and employees in comparison to the number of people they accommodate (Bryant, 2020). Cruise ships exhibit a structural resemblance to floating hotels since they possess comprehensive hospitality personnel in addition to the customary ship's crew. It is fairly common for the most opulent vessels to possess a greater number of crew members and employees in comparison to the quantity of people they accommodate.

Cruise vessels produce many waste streams that have the potential to be discharged into the marine ecosystem. These waste streams include wastewater, sewage, dangerous materials, greasy sump water, water from ballast tanks, and solid garbage. In addition, they release air pollutants into the atmosphere and water bodies. If these wastes are not appropriately processed and disposed of, they may represent a substantial risk to human health and aquatic life due to the presence of infections, nutrients, and hazardous compounds. The majority of cruise ships mostly use heavy fuel oil (HFO), sometimes referred to as "bunker fuel. Due to its elevated sulphur content, the combustion of this fuel leads to sulphur dioxide emissions that surpass those produced by comparable road traffic. The user's text does not contain any information to rewrite in an academic manner (CDC, 2020). The MARPOL IV-14 agreement, an international accord, mandates that cruise ships use gasoline with a maximum sulphur content of 0.10% or employ exhaust gas scrubbers to mitigate sulfur oxide emissions to a level equivalent to that of an engine operating on fuel with less than 0.1% sulfur. Cruise ships typically allocate 60 percent of their fuel energy for propulsion purposes, while the remaining 40 percent is used for hotel activities. However, it is important to note that the specific loads and allocation of fuel energy may vary significantly depending

on prevailing circumstances. The user's text does not contain any information to rewrite in an academic manner (CLIA, 2021).

There exists a claim asserting that the air pollution arising from marine transport, including cruise ships, is causally linked to an estimated annual death toll of 50,000 individuals within the European region. Certain cruise lines, such as Cunard, have implemented measures aimed at mitigating their environmental footprint. For instance, Cunard has adopted a zero-discharge policy, abstaining from any kind of discharge. Additionally, the company has made consistent efforts to decrease its annual carbon dioxide emissions. Cruise ships need electrical power, typically sourced from diesel generators, however there is a growing trend of using liquified natural gas (LNG) as fuel for newer vessels. During the docking process, ships are required to operate their generators continually in order to provide power to the various facilities on board, unless they have the capability to use onshore electricity, if it is accessible. Certain cruise ships now include the use of shorepower, although others are undergoing modifications to enable its implementation (CLIA, 2020).

There is an urgent need to understand the importance of cruise industry and to act responsible for reducing its pollutants that are released in seas and oceans by adopting sustainable strategies. Countries like In the city of Venice, there has been a persistent advocacy for the implementation of a prohibition on the entry of big cruise vessels into the historically significant area.

In the year 2023, Ada Colau, the Mayor of Barcelona, expressed her support for implementing restrictions on the influx of cruise ships into the city. At present, during the peak season, the number of individuals disembarking amounts to around 200,000 each month. The implementation of Colau's proposed procedures has the potential to reduce this figure by half. According to research conducted by Transport and Environment in 2019, Barcelona was identified as the European cruise port with the highest levels of air pollution. Hurtigruten, a Norwegian-based specialized firm, is now engaged in the experimentation of several technologies, including the implementation of retractable sails that serve the dual purpose of functioning as solar panels as well as the substitution of fossil fuels with batteries. The company's objective is to achieve the status of becoming the world's first cruise line with zero emissions by the year 2030 (Carnival Sustainability, 2022).

II. CARBON EMISSION AND RISK OF CLIMATE CHANGE

Cruising serves as a means to explore and experience some of the finest, unspoiled and awe-inspiring locations on the planet. While it’s a perfect way of exploring destinations, the cruise industry is on the verge of facing acute climate change due to its own existence and usage of resources, as well as dumping toxic products along with the whole process.

The calculations would change a lot if the effects on the climate of short-lived climate pollutants (SLCPs), like methane, black carbon, and airplane contrails that stick around for a long time. Although there is some uncertainty, scientists now posit that the combined climate effect of flying, which includes both carbon dioxide (CO2) emissions and short-lived climate pollutants (SLCPs), is around three times greater than that of CO2 emissions alone. However, it is worth noting that cruise ships also release short-lived climate pollutants (SLCPs), with

methane being a significant contributor. For the sake of this research, we will focus only on comparing CO2 emissions between cruise ships and aircraft (Caric, 2016).

Cruise ships possess the dual functionality of serving as floating accommodations, hence warranting the inclusion of emissions stemming from hotel stays in air travel assessments. Based on a recent study conducted by Cornell University in 2021, it has been determined that a single night's accommodation in a 4-star hotel inside the United States is associated with an estimated emission of around 30 kilograms of carbon dioxide equivalent (kgCO2e) per room per night. If it is assumed that there are two individuals occupying each room, the number may be halved. The rates are much more affordable for hotels of lesser prestige. To facilitate comprehension, let us assume that the carbon dioxide equivalent (CO2e) is equivalent to carbon dioxide (CO2). In the scenario where an individual embarks on a 5-night cruise over a distance of 2,000 km, it can be shown that the carbon dioxide emissions attributed to this passenger amount to 500 kg CO2, assuming the use of the most environmentally friendly cruise ship line with a carbon footprint of 250 g CO2 per passenger-kilometer. There is a growing trend among newly developed cruise ships to use methane as a fuel source, namely in the form of liquefied natural gas (LNG). According to Clarksons, over 50% of newly constructed cruise ships are now being designed to operate on liquefied natural gas (LNG), based on gross tonnage measurements. Although a reduction in direct airborne pollutants is seen, it is important to note that cruise ships' engines emit unburned methane, contributing to atmospheric methane levels (CLIA, 2020; CLIA, 2021). The phenomenon referred to as "methane slip" contributes to increased life-cycle greenhouse gas (GHG) emissions that are produced in engines compared to the use of low-sulfur marine gas oil, as shown by our study findings.

The world’s reckoned organization, the Cruise Lines International Organization (CLIA) was founded in 1975 and is now recognized as the biggest trade organization in the cruise industry worldwide. It serves as a cohesive entity and authoritative body for the worldwide cruise community. The Cruise Lines International Association (CLIA) advocates for regulations and procedures that cultivate a cruise ship environment that is safe, secure, healthy, and sustainable. CLIA is committed to the promotion of the cruise vacation experience. The Cruise Lines International Association (CLIA) caters to an annual passenger volume of 28.5 million individuals (CLIA, 2021).

III. DECARBONIZATION IN CRUISE LINES

The cruise lines are aware of the negative impact it puts on the marine environment. Adopting decarbonization is proposed to support the transition to alternative fuels and technologies, such as biofuels, large-scale batteries, and fuel cells. The 2030 goal is aligned with the International Maritime Organization’s commitment to reduce carbon emission intensity by 40% by 2030, and the cruise sector aspires to achieve net carbon-neutral ship operations by 2050. It is to be noted that achieving this aspiration will require energy sources and technologies that do not yet exist for our industry. Regardless, the efforts to date have resulted in peaking our absolute carbon emissions a decade ago, and the scientists are working hard to find ways to further reduce our absolute emissions. The cruise lines are demonstrating a focused commitment to decarbonization, which comprises expenditures totaling several millions of dollars and a plan consisting of many facets (Coulter, 2020). Adopting global regulations and engaging with industry regulatory authorities to handle impending regulatory needs and circumstances are key components of this plan. The strategy

also includes a number of other key components. Increasing the fleet's overall efficiency to its full potential.

- Taking out of service ships that are less productive.
- Utilizing alternative fuels with lower levels of carbon emissions such as LNG and bio-LNG.
- Putting money into carbon-efficient technology like batteries and fuel cells, for example.
- Providing assistance to and putting additional speed behind industry-specific R&D initiatives.
- Collaboration with other businesses, non-governmental organizations (NGOs), and other important stakeholders.

The 2022 study reaffirms the cruise industry's reputation as a leader in the development of environmentally friendly technology and an early adopter of these innovations. Examples highlighted include the rising number of boats that will be launched over the next several years and that will be able to include zero-emissions propulsion when it is available, as well as the increased investment that is being made to equip ships with the ability to tap into shore side energy when it is available. Both of these examples are promising developments. In fact, more than 15 percent of the vessels that are going to be introduced in the next five years will incorporate fuel cell technology or batteries, and 85 percent of CLIA-member vessels will be able to hook up to shore side electricity. This will enable the engines to be turned off at the berth, which will result in a significant reduction in emissions (Claric, 2016).

In spite of the progress that has been made, the report makes it abundantly clear that switching to sustainable marine fuels is still essential to achieving the decarbonization goals of the maritime industry. It also highlights the urgent need for authorities to support studies intended to speed up the development of such fuels so that they are safe, viable, and available for use at scale. In this regard, the Cruise Lines International Association (CLIA) is an amplifying organization for the Call to Move for Decarbonization of Shipbuilding issued by the Going to Zero Coalition.

IV. ALTERNATIVES FOR BETTER CLIMATE RESILIENCE

According to Pierfrancesco Vago, the CLIA Global spokesperson, for the next phase of our industry's journey to reach net-zero emissions, the industry requires unambiguous support from authorities and policymakers. This support is necessary to ensure that the appropriate infrastructure is developed not only on land but also at sea, and it is also necessary to encourage the expenditures and creativity that will be necessary for the invention of sustainable marine petroleum products at scale. The cruise sector, after the post-pandemic world, is regaining momentum, and in such demand, they are willing to implement different strategies to combat climate change by reducing emissions (Trivyza et.al., 2019) through

- **The Capability to Connect to Power from Shore:** Cruise companies continue to make large expenditures so that cruise ships can connect to energy from shore, which enables the engines to be turned off while the ship is docked. Forty percent of the

world's capacity can now run on shore-side power, which is an increase of twenty percent year over year. This capability is only available at 29 ports across the globe, which is less than two percent of all ports in the world. Each of these ports has at least one berth that has this capability. Ninety-eight percent of the new-build capacity that is now on order book will either be committed to being outfitted with shore-side electrical systems or will be structured to add shore-side power in the future. This span of time covers the period between now and 2028.

- **Liquefied Natural Gas (LNG) Fuel:** According to the research from 2022, 61 percent of new-build equipment would depend on LNG fuel as the major propulsion source. When LNG is used, there is a decrease of particulate matter (PM) pollutants of between 95 and 100 percent, almost no emissions of sulfur, and a reduction of nitrogen emissions of 85 percent. The use of liquefied natural gas (LNG) as a transitional fuel not only offers immediate advantages, but it also makes it possible for LNG-equipped ships to transition to a subsequent generation of environmentally friendly marine fuels.

- **Exhaust Gas Cleaning Systems (EGCS):** It has been noted that 80 percent of the worldwide capacity uses EGCS to meet or exceed air emissions regulations; this is a capacity growth of seven percent compared to 2021. EGCS is used to meet or exceed air emissions requirements. In addition, 88 percent of the capacity of non-LNG new buildings will have EGCS installed, which is in keeping with the historically high level of expenditures that have previously been made.

- **Advanced Wastewater Treatment Systems:** Currently, 78 percent of the vacation rental fleet's total capacity is provided by advanced wastewater treatment facilities, which is a nine percent increase compared to 2021. Additionally, all newly ordered ships are required to be equipped with advanced wastewater treatment systems.

The industry's earlier this year announced commitment to strive for net-zero carbon cruising by 2050 is in line with the objective set forth by the Paris Agreement. This commitment is supported by the industry's intermediary goal of lowering the carbon emissions rate by 40 percent throughout the worldwide fleet by 2030, and it is in line with the Initial Strategy for GHG Reduction developed by the International Maritime Organization (IMO). There are said to be major alternatives being proposed to help cruise lines be climate resilient and harmless in the future (Kulkov et.al., 2022; CLIA, 2021).

1. **Fuels of Alternative Sources:** In particular, we are increasing the organizations' financial commitment to the use of low-carbon fuels.

- Natural gas that has been liquefied, or LNG. the industry and cruise organizations are in the process of ordering seven additional LNG vessels. These cutting-edge vessels produce much lower levels of carbon emissions compared to conventionally propelled vessels, while also virtually eliminating levels of sulfur oxides (SOx), and other pollutants.
- Liquified biomethane, often known as bio-LNG. This biofuel is produced by the processing of organic waste flows, and it is essentially CO2 neutral. It also has all of the benefits that LNG does but diesel does not, including decreased CO2 emissions,

along with quieter engine noise, no SOx, much lower particulate matters emissions, and significantly fewer other pollutants. While Shell and other suppliers are making the required investment to grow the technology and develop a dependable supply infrastructure.

- Synthetic LNG, also known as Liquefied Synthetic Methane (LSM), is produced by combining hydrogen derived from renewable sources with carbon obtained either by direct air capture or through carbon capture in order to produce methane in its purest form. It is possible to classify this option as either carbon-free or low-carbon, depending on the source. Even if this is not now a financially feasible option, it is one of the routes that we are investigating in order to assure the continued profitability of our LNG boats in the long run.
- Green Ammonia: It is considered the modern-day fuel for zero carbon emissions. Hy2gen and Trafigura have signed a Memorandum of Understanding to collaborate on the development of research that will quantify the infrastructure and production needs for green ammonia in order to decarbonize the maritime sector throughout the transition to low and zero carbon marine fuels. The research will analyze the essential factors necessary for large-scale commercial adoption. These aspects will include the required amounts of green ammonia as well as the transport and storage capacity that will be required. Building the infrastructure necessary to allow an efficient supply chain that is capable of delivering adequate amounts of the 100 percent sustainable and pollutants-free green ammonia to market would require massive commitments in production, infrastructure, and shipping modifications. The purpose of the research is to quantify these types of commitments.
- Green Methanol: According to researchers at the Oko-Institut in Germany, which is a charitable organization research and consulting center, green methanol is now regarded to be the most promising fuel. This opinion was presented by the researchers. According to Nora Wissner, one of the authors of a research conducted by the Oko-Institute, if methane is created using renewable energy as well as carbon dioxide that is taken from the atmosphere, then cruise ships might be powered in a manner that does not have a negative impact on the environment. However, the most significant issue is that there is now insufficient production of green methanol in adequate amounts. The current state of affairs makes it impossible to operate a cruise ship in a manner that is kind to the environment (Carnival Sustainability, 2022).

2. **Connections to the Shore Power System:** Instead of utilizing the ship's engines and fuel to create power, cruise ships that are equipped with shore power capabilities may plug in to particular port connection facilities. This allows the ship to receive energy directly from the electrical grid in the port, rather than having to use the ship's own engines. When compared to non-renewable forms of electricity generation like fossil fuels, the effects of climate change and air pollution caused by renewable sources of electricity generation like hydro, solar, wind, and geothermal are far less severe. There are around 21 ports out of the more than 700 ports around the globe that requires necessary infrastructure to give shore power hookups to cruise sector’s fleet.

The major connected ports are: Hamburg, Germany; Seattle, Washington; Vancouver, Halifax, and Montreal, Canada; Juneau, Alaska; San Diego, San Francisco; Kristiansand, Norway; and Shanghai, China. Based on different cruise itineraries and the capabilities of ships that frequently visit those ports, the cruise lines are able to connect in

these ports. Half of these ports have acknowledged that they get their power from renewable sources including hydro, wind, and solar, amongst others. The other half have not validated this information. A further 20% of the fleet is scheduled to be outfitted with the capability to deploy cold ironing/shore power technology by the year 2030. Currently, 40% of the fleet owned by Carnival Corporation & plc is equipped with this technology (ECDC, 2020).

3. **Technologies that are Carbon-Efficient:** In 2019, cruise lines made publicly an announcement on a collaborative initiative that) will be carried out by Carnival Corporation & plc, the Meyer Werft shipyard, Freudenberg Sealing Technologies, and a number of other partners, with funding coming from the German Federal Ministry of Transport and Digital Infrastructure. The mission of the "Pa-X-ell2" project is to identify doable strategies for achieving climate-neutral mobility throughout the entire maritime industry. Hydrogen created from methanol will provide the fuel cells with their energy source.

    - Electrochemical batteries: In 2019, the organizations secured a contract with Corvus Energy to commence manufacture and installation of a first-of-its-kind lithium-ion battery storage facility on board a cruise ship. This system will be installed on a ship in the Caribbean. The technology is presently in the process of becoming the biggest battery storage system that has ever been put on a passenger ship anywhere in the world.
    - NAUTILUS is an acronym that stands for "Nautical Integrated Hybrid Energy System." It is the name of a research project that is being sponsored by the European Union's Horizon 2020 program. Despite the fact that AIDA Cruises, which is owned by Carnival Corporation and plc, is the only cruise line that is taking part in this initiative.

4. **Ships Used for Recycling:** The process of dismantling and recycling a ship occurs at the conclusion of that vessel's life cycle. The process of reusing, recycling, and disposing of waste materials is a complicated one that involves a lot of different components. The track records of compliance with important worldwide environmental protocols and laws led to the selection of EGE CELIK and SIMSEKLER, both of which are located in Turkey, as the companies to recycle three decommissioned cruise ships by Carnival Corporation & plc. The Hong Kong Convention held for the Secure and Sustainable Recycling of Ships has granted certification to both of the recycling firms. In addition to this, they are mandated to closely conform to a complicated matrix of global norms that have been established by the European Union (EU), the International Maritime Organization (IMO), the International Labor Organization (ILO), and the multinational environmental accord known as the Basel Convention (CLIA, 2021).

    In addition, in order to devise a method for disassembling and recycling the ships, we collaborated with the environmental organization Bellona Foundation, which is a leading participant in the NGO Shipbreaking Platform, as well as the specialist ship recycling experts Sea2Cradle. This allowed us to come up with a plan. In addition, the organizations assisted in the identification of best-in-class certified marine vessel retirement solutions throughout the globe. These solutions are able to reuse, recover, and

recycle decommissioned ships to a healthy, sustainable and climate resilient cruise industry.

V. CHALLENGES

The tourism sector, which includes the cruise industry, is at a critical juncture as a consequence of growing concerns over the state of the environment and increased attention from the general population. It is plainly obvious that there is an urgent need for a sea shift as a consequence of ports in Europe like Amsterdam banning or blocking large cruise ships as a result of pollution and over-tourism. This is due to the fact that large cruise ships contribute significantly to the problem of over-tourism. The Port of Seattle acts as an example for creating a sustainable balance between economic growth and environmental preservation by establishing a goal to remove all port-related pollutants by the year 2050 via the utilization of shore-based electricity (CLIA, 2021). This goal was established with the intention of making the Port of Seattle a zero-emissions port by that time. This is a step in the right direction, yet the company is still dealing with issues such as poor wastewater treatment, overutilization of fuel, and overcrowding despite this excellent move. The results of a study that was carried out by Transport & Environment indicate that the luxury cruise vessels that navigate the waterways of Europe create the same quantity of harmful sulphur as one billion vehicles. Specialized cruise companies like Hurtigruten are at the forefront of pioneering efforts to turn cruise ships into zero-emission boats. These cruise lines are studying innovative technologies such as flexible solar panels and battery packs in order to achieve this goal (Kulkov et.al., 2022).

In spite of the heartening progress that has been achieved, there are still many challenges to conquer. Due to the fact that only sixty percent of cruise ships are fitted with contemporary sewage treatment systems, cruise ships often release garbage into the ocean that has not been cleaned. This may have negative effects on marine life. In addition, the petrol that is used on cruise ships is many thousands of times more damaging than the gasoline that is used in vehicles. This is because cruise ships burn their fuel at a higher rate.
Another issue is that many ports do not have the necessary facilities in place to provide energy to the docks. This is a concern at a number of different ports. There are certain drawbacks to using liquified natural gas (LNG) as a more environmentally friendly fuel option. For example, LNG-powered ships contribute to climate change because of methane leakage. The natural decomposition of the LNG's methane is the root cause of these leaks.

In spite of the fact that the cruise ship industry has high hopes for a future that is less harmful to the environment, environmental groups will not stop putting the players in that sector to the test. For example, the Nature and Biodiversity Conservation Union (NABU), which says that the pace at which progress is being made to decrease emissions is inadequate, asserts that progress is not being made rapidly enough. They say this because they believe that the speed at which advancements are being made to reduce emissions is insufficient. A German environmental protection organization is responsible for compiling and publishing an annual ranking of the climate protection initiatives that were undertaken by European cruise ship operators. According to the findings of the study for this year, "climate preservation and cruising do not work hand in hand. A survey was carried out by NABU in which 13 of the most well-known cruise lines were asked about the measures they were taking to lessen their negative influence on the environment. Not even the people who finished in first place overall had very high score totals.

In a manner fairly dissimilar to this, the international environmental nonprofit Friends of the Nature has not been bashful in expressing its dissatisfaction. A recent study found that someone enjoying a vacation on a cruise ship emits nearly eight times as much greenhouse gas as emissions taking a break on land. These emissions come from the ship's engines and generators (Kulkov et.al., 2022).

According to NABU, almost fifty percent of all cruise ships now in service utilize fuel derived from petroleum, despite the fact that this kind of fuel has an unfavorable record with regard to preserving the environment. Environmentalists are of the view that, at the very least, the change from gasoline to marine diesel engines and the installation of so-called carbon pollutant filters and converters for catalytic inhibition ought to have happened a very long time ago.

VI. CONCLUSION

After the epidemic is over, cruise companies have a responsibility to their passengers as well as to the environment to lessen the damage they have done so that safe sailing may continue. Switching to really environmentally friendly fuels like green ammonia when they become commercially accessible, as opposed to climate-damaging choices like LNG, would result in a significant reduction in the sector's overall carbon footprint. Scrubbers are another component that cruises should avoid at all costs, or at the very least, they should look into completely closed-loop networks that store scrubber effluent rather than open-loop systems that dump it back into the ocean.

In conclusion, installing innovative water treatment systems that are in good working order and capable of treating both graywater and wastewater should be a top priority. Passengers on cruises see a number of the most breathtaking locations on the planet, and after the voyage has resumed, those on board will have the satisfaction of knowing that they won't be leaving anything behind as they continue on their journey.

For instance, in the year 2020, we set up a separate department devoted to environmental, social, and governance (ESG) in order to expand the scope of our Sail & Sustain Environmental Program and increase its overall effect. The Environmental, Social, and Governance (ESG) team provides support for important environmental projects and guarantees the synchronization of our ecological agenda across a wide variety of departments, including those dealing with health and safety, human resources, legal matters, and even our supplier chain (Carnival Sustainability, 2022). As part of the Sail & Sustain initiative, the cruise organizations are working to minimize the amount of garbage that is transported to landfills, lower our CO2 emissions, increase our usage of commodities that are obtained in a more environmentally responsible manner, and make investments in new environmental technology. The CDP is a global environmental non-profit organization that reviews 9,600 firms across the globe each year. They recently recognized us with a 'B' climate change score as a consequence of our ongoing efforts; this score is an improvement over the previous year's score and is better than the average score for the marine transport sector.

After forming a collaboration with JUST Water through JUST® Goods, Inc. at the beginning of 2020, NCL became the first major worldwide cruise line to eradicate the use of single-use plastic bottles aboard our fleet and at private locations. This development comes as

a direct result of that accomplishment. An agreement has been made among organizations and the Port of Southampton for the latter's new terminal, which will incorporate both shore energy and roof-mounted solar power to deliver clean, green, renewable energy and further enhance our commitment to a sustainable future for the industry. In addition to that, there is the problem of ship manufacturing. Putting together a cruise ship requires a significant investment of time and money, often running into the millions of dollars. As a consequence of this, the lifespan of a ship is often estimated to span many decades. Because of the quick advancements that are being made in the realm of substitute fuels, it is very difficult to keep a full fleet up to speed on the latest information (Carnival Sustainability, 2022).

A zero-emission cruise is thought to be the future of cruise tourism; however, there is a long way to go and a lot of commitment required to attain such goals. However, in the matter of being a climate-resilient industry, cruise organizations are under a lot of pressure to make their next generations more green and sustainable than the present.

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