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The Fjords of the Future:

Balancing Norway's Cruise Tourism Strategy with Environmental Concerns.

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Tourism Management
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Preface

This bachelor's thesis marks the end of three exciting and enriching years studying Tourism Management at the Norwegian School of Hotel Management, University of Stavanger. Our time here has equipped us with extensive and in-depth knowledge of the tourism sector - its opportunities and challenges - and how we can contribute to a more sustainable industry that benefits all stakeholders.

We would like to express our most sincere gratitude to our supervisor Åsa Helen Grahn for all her invaluable guidance and insightful feedback throughout this period. Her support and expertise have helped shape the project and provided us with new perspectives which we had not considered.

Further, we would like to thank our families and friends, which have been of great support these months. We are grateful for your patience, support, and encouragement throughout the process – especially during the most demanding periods of this project.

We are grateful to our professors, peers, and friends, whom we have been so fortunate to meet throughout our time at the University of Stavanger.

And finally, we are grateful to each other, and the cooperation we have had over the past three years as both peers and friends. Supporting each other, cheering one another on and aiding each other towards improvement.

We look forward to applying the insights and skills acquired throughout our academic journey, as we embark on new opportunities within this industry.

Liv Bjerknes and Marte Hemmingsen

Abstract

This bachelor's thesis investigates whether cruise tourism can be environmentally sustainable and how Norway can develop its cruise tourism sector within its national tourism strategy to enhance sustainable practices and meet its environmental goals. The research involves a literature-based approach, analysing eight articles against international and national legislations and guidelines. By comprising the latest research, the conclusions made in this thesis can serve as a good foundation for decision-making processes regarding the future of cruise operations in Norway.

Cruise tourism is a rapidly growing and increasingly popular means of travel. Technological advancements have enabled larger ships, consequently increasing the environmental impact. The Norwegian UNESCO World Heritage fjords have seen a growth in visitors, and being a vulnerable area, mitigating negative impacts is imperative to preserve the natural beauty of the destination. In response, Norway is advancing towards greener, more regenerative tourism practices, which include a goal of zero-greenhouse gas emissions from cruise ship operations in these fjords by 2026.

The research shows that air pollution is the most central subject and that current operation emissions are not in line with international strategies to minimise greenhouse gas emissions rapidly. With the current sectoral growth, including Norway's requirements for the World Heritage fjords, achieving net zero emissions by 2050 seems unlikely. Alternatives such as biofuels and onshore power supply are proven to reduce emissions, yet challenges such as cost and limited availability hinder their feasibility. Sectoral growth leads to increasing waste generation, necessitating international standardisation of waste handling laws and improved collaboration between ports for cost-effective, eco-friendly waste management.

While a commendable step, the zero-emission requirement in the World Heritage fjords most likely will lead cruise traffic to relocate to other fjords. Other proposed measures from the report are law for limiting the maximum number of cruise passengers and calls per day, and points to the need to look at the framework conditions for cruise operations in Norwegian waters. In order to truly embrace environmental sustainability, the cruise sector must adopt a more proactive approach, aiming for de-growth and implementing regenerative operations.

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Abbreviations

AI	Artificial Intelligence
APA	American Psychological Association
ASP	Academic Search Premier
AWTS	Advanced Wastewater Treatment System
CAN	Climate Action Network
CLIA	Cruise Lines International Organization
CO_2	Carbon Dioxide
CSC	Clean Shipping Coalition
DNV	Det Norske Veritas
GHG	Greenhouse Gas
GT	Gross Tonne
HTC	Hospitality and Tourism Complete
ILC	International Law Commission
IMO	International Maritime Organization
LBG	Liquified Biogas
LNG	Liquified Natural Gas
MARPOL	Marine Pollution
Mt	Mega tonnes
NESH	National Committee for Research Ethics in the Social Sciences and the Humanities
NOU	Norwegian Official Report (Norges Offentlige Utredninger)
NO_X	Nitrogen Oxide
NVE	The Norwegian Water Resources and Energy Directorate
OPS	Onshore Power Supply
$PM_{2.5}$	Particulate Matter
SO_X	Sulphur Oxide
UNCLOS	United Convention on The Law of the Sea
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNWTO	United Nations World Tourism Organization
WoS	Web of Science

1 Introduction

Cruising is a formidable alternative to land-based and stationary tourism. It offers a comprehensive travel experience by combining transportation, accommodation, entertainment, attractions, and guided tours, all in one place (Špoljarić, 2020). This has made it a popular means of travel, and the industry has experienced rapid growth over the past decades. From 2009 to 2019, global cruise passenger numbers increased by almost 70% (Johansen et al., 2021), and in 2019, cruise tourism represented 10% of the total tourism arrivals (Papathanassis, 2019). This growth is forecasted to continue, and the Cruise Lines International Organization (CLIA) expects that 39.5 million passengers will travel on an ocean cruise holiday by 2027, an increase of 9.8 million passengers (33%) from 2019 (CLIA, 2023).

Norway's UNESCO World Heritage fjords are a popular destination for international cruisers. According to the Norwegian Coastal Administration's database, there were almost 1.9 million more cruise passengers in Norway throughout 2023, than in 2022. This amounts to over 6.1 million passengers in 2023. In addition to the increase in numbers, the season for cruise traffic in Norway has been extended, with more arrivals in the shoulder seasons. The data also show that the ports of Ålesund and Bergen are the most visited. These are the preeminent ports close to the UNESCO fjords, which makes them a prevalent starting point for many cruise travellers. The Norwegian Coastal Administration estimates an increase of 4% in the number of cruise calls and 6% in the number of passengers for 2024 (The Norwegian Coastal Administration, 2024), which illustrates that the popularity growth is also evident in Norwegian waters.

With high demand, the industry responds with increased supply. The international cruise fleet has recently introduced several new ships to the market, with more planned to set sail within the next three years (CLIA, 2023). In line with increased market interest within climate-friendly tourism, the new ships have been developed with the latest technology to make them more sustainable. At the same time, they are built to accommodate more guests, with the largest ships accommodating up to 6,000 passengers. Can such mega-ships be operated in an environmentally friendly way? Moreover, are the destinations prepared to accommodate such numbers of visitors simultaneously, considering most ports have a high number of calls per day when in high season?

1.1 Environmental Impacts of Cruise Tourism

As with every type of tourism, cruising has advantages and disadvantages that affect the destination's environment, economy, and local community. CLIA (2023, p. 40) reported an economic contribution of 75 billion USD and support of ~848,000 jobs globally through the cruise industry in 2021, which advocates for further growth. However, several reports and publications underscore the correlation between the augmented scale of vessels, amplified passenger capacity and elevated level of emissions, solid waste generation and wastewater discharge show that larger ships with more people onboard generate more air pollution, solid waste, and wastewater. In addition, overcrowding at destinations may negatively impact the local population and environment (Hoarau-Heemstra et al., 2023; Johnson, 2002; Špoljarić, 2020). Even though cruise ships represent less than 1% of the total number of maritime vessels, it is estimated that they contribute a quarter (25%) of all waste generated by the global merchant fleet (Butt, 2007, p. 592; CLIA, 2020, p. 1). Findings show that mega-ships consume at least 150 tonnes of fuel daily and that "Carnival Cruise Corporations vessels produced ten times more disease-causing sulphur oxide than all of Europe's 260 million passenger cars combined in 2017 alone" (Sarnelli, 2020, p. 1045). Transport & Environment (2023) reports SO_x emissions contribute to more than 250,000 premature deaths per year worldwide. These examples showcase the immense effect these ships and this industry have on the local and global environment.

Sustainability is threefold; it encompasses economic, social, and environmental impacts. Because this is a bachelor's thesis with only 19 weeks and a word-count limitation of 12,000 words, environmental sustainability is the primary focus.

1.2 Problem Statement and Implications

Cruise tourism represents a significant economic driver worldwide, yet its environmental impacts raise concerns about its sustainability (European Commission. Directorate General for Maritime Affairs and Fisheries et al., 2023). Due to the heightened interest in environmental conservation, understanding the feasibility of achieving environmental sustainability within the cruise tourism industry becomes imperative. Based on this, this thesis aims to explore the potential for environmental sustainability within cruise tourism, considering existing practices,

technological innovations, and regulatory frameworks. The primary problem statement has thus been created:

"Can cruise tourism be environmentally sustainable?"

Norway has fronted an ambitious climate policy and vision of regenerative tourism for the future (NOU 2023:10, 2023, p. 10). As a popular cruising destination, we want to investigate whether cruise tourism in Norwegian waters can become environmentally sustainable. Secondary data is analysed and put into the context of cruise operations in Norway, and the results will provide guidance on how future cruise tourism strategies aiming for zero emissions by 2050 can be designed. This brings us to the secondary problem statement:

"How can Norway develop its cruise tourism sector within its national tourism strategy to enhance sustainable practices and meet its environmental goals?"

The thesis study aims to shed light on the opportunities and obstacles associated with fostering sustainable cruise tourism, and three main objectives have been outlined to guide the exploration and analysis of this issue. By analysing the industry from an environmental view and considering opportunities and obstacles accumulating sustainable cruise tourism, this study has the following objectives:

1. Provide a comprehensive understanding of the environmental challenges of cruise tourism today.
2. Identify the practices and technological advancements available today that contribute to bringing the cruise industry closer to environmental sustainability.
3. Offer evidence-based recommendations for Norwegian legislative assemblies and stakeholders on the path towards environmental sustainability in cruise tourism.

This literature review thesis analyses data from case studies and peer-reviewed articles. The results are systematically presented and will be used to place the cruise industry in a sustainability model called Degrees of Sustainability (Page & Connell, 2020a, p. 412; Turner et al., 1999). The goal is to gather and analyse sufficient data to facilitate a comparative assessment of international practices against the practices in the Norwegian fjords. This makes it possible to assess if cruise operations in Norway align with the national governments and the European Union's strict and comprehensive environmental targets. Should the data indicate that current operations fall short of these environmental objectives, alternative strategies should be

explored. Conversely, should the findings suggest that sustainable cruise tourism is achievable, adjustments to the secondary problem statement may be warranted.

This review improves decision-makers' accessibility to findings by compiling the latest research into one document. The conclusions drawn will provide critical insight to help decision-making regarding future management of the cruise operations along the Norwegian coastline and ensure that policy development is informed by up-to-date and comprehensive data analysis.

2 Literature Review

CLIAs forecasts indicate that the cruise fleet will consist of over 300 ocean-going vessels for the first time in 2024 (2023, pp. 25, 48–49). The increased popularity is also visible in research, especially as technological solutions constantly develop, and an expanded fleet brings more significant impacts in all fields. Many articles, legislation, frameworks, and reports have been published in recent years that deal with the cruise industry and its effects on the environment and economy. Considering the development of the UN's sustainability goals and the internationally increased awareness of climate change, international organisations, the industry and the tourists have a greater focus on a greener cruise industry. This chapter provides an overview of essential legislation and previously conducted research on the topic, which will serve as the framework for discussing the findings made through this thesis.

2.1 Definitions

2.1.1 Cruise Ship and Cruise Tourism

It is essential to define key terms frequently referenced in this literature review. Firstly, the definitions of "cruise ship" and "cruise tourism" must be set. A cruise ship is a vessel that visits several places. It offers high-standard cabins and services, inclusive meals and onboard leisure activities, and one can buy excursions separately (Arntzen, 2023; Cambridge Dictionary, 2024). A necessary clarification in this context is that the Norwegian "Hurtigruten", colloquially referred to as a cruise ship, functions as a ferry and thus does not fall within this formal definition as cruise ships do not carry commercial cargo (Dybedal, 2018, p. 9).

Cruise tourism has been a significant component of Norwegian tourism since the 2000's. It comprises cruise agents, destination companies, and other tourism businesses across various sectors (NOU 2023:10, 2023). The European Commission presents cruise tourism as a complex ecosystem affecting numerous stakeholders, which illustrates the interconnectedness of cruising to other sectors (European Commission, 2023, p. 25).

2.1.2 Responsible and Sustainable Cruise Tourism

Sustainability within cruise tourism has a heightened focus internationally, which is emphasised by the vast body of literature, both academic research papers and official reports discussing ways of making the cruise industry more sustainable. However, there seems to be a lack of a

clear definition of sustainable cruise tourism, and only some discuss the feasibility of measuring and criteria for defining sustainable tourism. Even the report from the European Commission on "Good Practices for Sustainable Cruise Tourism" (2023) fails to bring a direct definition to the table. Similar to many other publications on the subject, it instead refers to how cruise tourism can be "more sustainable" (Carić & Mackelworth, 2014; Hoarau-Heemstra et al., 2023; Römhild-Raviart et al., 2019; Yu & Shao, 2021).

The referenced CLIA report is no exception. It proclaims cruises *as "a model for responsible and sustainable tourism"* (2023, p. 16). This is an interesting claim and leads to the need to define "responsible and sustainable tourism" to know what the phrase *really* means, as the report fails to provide a definition. The United Nations World Tourism Organisation (UNWTO) defines sustainable tourism as tourism that considers its economic, social and environmental impact, addressing the needs of visitors, the industry, the environment and host communities, now and in the future (UNWTO, n.d.).

The same problem arises when looking for a definition of responsible cruise tourism. Therefore, Page and Connell's definition of responsible tourism is applied: a *"form of tourism which acknowledges that mass tourism has negative impacts for host communities and destinations, and which seeks to generate positive benefits while minimising negative ones."* (2020b, p. 616). Due to lacking more accurate definitions, the general UNWTO definition of sustainable tourism and Page & Connell's general definition of responsible tourism are applied to cruise tourism in this thesis. The CLIA report (2023, p. 16), can, with this interpretation, be translated to:

"Cruise is a model for tourism that acknowledges that mass tourism has negative impacts on host communities and destinations. It seeks to generate positive benefits while minimising negative ones and takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities".

Arguments supporting said claim involve measures such as managed tourism, responsible sourcing for food and supplies, water production and conservation, sustainable and locally sourced tour excursions, and ocean and marine life protection. The question becomes: Are these measures comprehensive enough to fully account for cruise ships' current and future economic,

social, and environmental impacts? Furthermore, are they addressing the needs of all stakeholders concerned: the visitors, the industry, the environment, and host communities?

2.1.3 Regenerative Tourism

Sustainable and responsible tourism emphasises how tourism should minimise its negative impacts. This brings us to the term "regenerative tourism". This term takes sustainability a step further than just minimising the impacts tourism has caused, and says that tourism should enable the area to grow or grow again (World Travel and Tourism Council, n.d.). Concerning cruise tourism, this would mean that for it to be regenerative, it must give something back to the areas visited so it can grow stronger. Consequently, the areas would be taken care of instead of deteriorating and thus destroying their basis of income.

2.2 International Legislation

Internationally, legislation specific to the cruise tourism industry has existed for years. In 1973, the International Convention for the Prevention of Pollution from Ships (MARPOL) was held. The treaty with the same name came five years later, containing six annexes with legal regulations on pollution in international waters from marine vessels. The treaty holds the partied countries obligated to give effect and run according to the restrictions in the annexes: preventing oil pollution, noxious liquids carried in bulk, standard packaging and limitations for harmful substances, discharge of sewage into the sea, prevention of garbage pollution and lastly, limits on SO_x (sulphur oxide) and NO_x (nitrogen oxide) emissions (International Maritime Organization, 1978).

When discussing sustainability and climate change, it is natural to reference the 2015 Paris Agreement, which defines a goal of limiting temperature increase to 1.5 Celsius above pre-industrial levels. Achieving this goal would mean that greenhouse gas (GHG) emissions must peak in 2025 and subsequently reduce by 43% by 2030 (UNFCCC, 2015). For international shipping, which includes the cruise fleet, it is estimated that absolute emissions from this industry will need to drop to zero by 2050 at the latest to be in line with the Paris Agreement (CAN & CSC, 2018, p. 2).

With the ambitious goal of phasing out GHG emissions from international shipping as soon as possible and reducing them by at least 70% within 2040, the IMO has created the "*2023 IMO*

Strategy on Reduction of GHG Emissions from Ships". The strategy includes a goal-based marine fuel standard, regulating the gradual reduction of marine fuel's GHG intensity and the economic element of maritime GHG emissions pricing mechanism (IMO, 2023).

These limitations and rules are interesting regarding our research question: "Can cruise tourism be environmentally sustainable?", as international goals seem to force the industry in that specific direction. A consistent focus on emissions and limitations suggests the need for new technology in order for the cruise industry to operate within sustainable goals.

2.3 Norwegian Legislations and National Reports

In January 2021, the Ministry of Climate and Environment delivered the recommendation for Norway's Climate Action Plan for 2021-2030, which was approved the same day in the Norwegian Parliament. A vital part of the plan is a policy aiming for a 45% reduction in non-quota emissions (from transport or agriculture) by 2030. It also points out Norway's obligation under the Paris Agreement to reduce the emission of greenhouse gases (GHG) by at least 50% and up to 55% by 2030, which is a crucial and decisive step toward becoming a low-emission society by 2050 (Meld St. 13 (2021-2030), 2021).

In addition, in 2023, a consultation on the proposed implementation of zero-emissions requirements in the Norwegian World Heritage fjords by 2026 was submitted by the Norwegian Maritime Directorate to the Norwegian Parliament. The proposal involves a separate regulation on GHGs, CO_2, and methane emissions in the World Heritage fjords and using the best available technology to reduce NO_x emissions (2023, p. 1). Both the Climate Action Plan and this consultation proposal come as a reaction to the resolution and demand from the Norwegian Parliament on zero emissions of GHGs for passenger ships in the World Heritage fjords from January 1st 2026. This should be done simultaneously, as arrangements must be made for the World Heritage fjords to be a port of call for cruise ships after this date (2023, p. 2).

On behalf of the Norwegian Maritime Directorate, Menon Economics conducted a socio-economic analysis assessing the zero-emission mandate's impact on the World Heritage fjords (Handberg et al., 2022, p. 3). The findings indicate a reduction in GHG emissions; however, they concurrently predict a decline in local economic development. The primary reason for the economic downturn is the anticipated rerouting of cruise traffic to alternative fjords, which may

threaten the vitality of the local communities of heritage fjords in terms of population stability, economic activity and employment. The overall national benefits of carbon footprint reduction and economic growth are deemed marginal as the shift is expected to balance out through increased emissions and economic output in other fjords. The mandate may result in reallocating GHGs and economic production to alternative and less-prepared destinations, potentially overwhelming these areas (2022, pp. 45–52). Despite these challenges, the policy's potential to strengthen Norway's international position as a leader in reducing tourism-related climate impacts and as a sustainable destination could stimulate tourist interest and possibly attract more visitors (2022, p. 45).

A report on the development of cruise traffic in Norwegian waters towards 2040 (DNV, 2021) presents different technologies for mitigating emissions from cruise vessels, such as the feasibility of alternative fuels and onshore power supply (OPS), as well as improved waste management. The report constructs three future scenarios to predict how the cruise industry will be able to cope with future regulations on emissions. With strict NO_x regulations, the most likely scenario predicts that the cruise fleet will adapt to the requirements and increase activity towards 2040. Norway is also investing in OPS systems in several ports and is currently one of the market leaders in offering green, shore-based electricity supply to vessels. However, not all infrastructures are compatible with international cruise ships (Jørgensen, 2020; Milne, 2022; NOU 2023:10, 2023; NVE, 2024). Disposal of cruise-generated waste is regulated by national laws, which build on the annexes in MARPOL (The Pollution Act, 1981; The Pollution Regulation, 2004). Another report focusing on a low emission future, NOU 2022 - Maritim 21, claims that "Norway will be a world leading maritime nation in 2030 through taking a leading position within the shift toward the green transition". Furthermore, the report points out the fact that only a few ports had the infrastructure to supply biofuels in 2022, despite biofuels being identified as one of the most effectful, available technologies for emission mitigation (NOU 2022:1, 2022).

Furthermore, in 2023, the Norwegian Official Report (NOU), "Live and Experience - Destinations for a Sustainable Future" (title translated for convenience), was released. One of the introductory visions in the report is that Norway should look to regenerative tourism as the best practice for tourism, aiming to create a positive effect on industry, local society, and the environment. The report discusses what the committee identifies as essential strategies for visitation management and funding public amenities, among various subjects. Further, it also

presents recommendations on destination development, visitor flow management and the governance of cruise tourism. Two main challenges in cruise tourism are pointed out: firstly, air pollution from cruise ships, and secondly, they highlight the mass-tourism challenges. Despite these critical challenges, the NOU committee did not recommend banning cruises in Norway (NOU 2023:10, 2023).

The mentioned reports all have a common factor: They view sustainable development mainly as reducing GHG emissions, focusing on only the first of the six environmental goals in the EU taxonomy (Meld St. 13 (2021-2030), 2021, p. 182). They leave out other important subjects such as circular economy, waste management, and protection of water resources. Should the analysed data furnish evidence supportive of environmental sustainability within the cruise industry, it becomes logical for Norway to continue facilitating coastal tourism. Conversely, if research findings contravene this notion, the question of whether Norway can incorporate cruise tourism within its prospective strategic initiatives as a viable investment sector arises.

2.4 Former Publications and Research

Johnson's (2002) life cycle analysis of tourism concludes that even though tourist operators are introducing more environmental considerations, mobile mass tourism challenges the idea of cruise tourism becoming sustainable. The analysis points to newer technologies as a solution to meet stricter pollution standards and visitor taxes as an economic contribution to environmental recovery (Johnson, 2002, p. 268).

A study commissioned by the European Commission, named "Good Practices for Sustainable Cruise Tourism", examines the economic, social and environmental status of today's operations in cruise tourism and looks closer at the most promising solutions to the most pressing challenges. As a backdrop to the study, the authors list the Green Deal (designed to produce a green economy), the Approach to a Sustainable Blue Economy and the Transition Pathway for Tourism (European Commission 2023, p. 15). "The European Green Deal" is the supreme framework toward sustainability of the three, and it aims to achieve net zero carbon emissions by 2050. Including the Fit-for-55 package of measures is supposed to ensure that the EU cuts its emissions with 55% by 2030.

Furthermore, the "EU Blue Growth Strategy" is a long-term strategy for sustainable growth within marine and maritime sectors (The EU Blue-Action project, 2021). Lastly, there is the EU's Transition Pathway for Tourism, which is not a goal-setting document but a strategy with suggestions for how a green and digital transition can be co-created with stakeholders within tourism (Council of the European Union, 2021). The publication focuses conclusively on these measures for cruise tourism to operate more sustainably: assure energy efficiency, the usage of OPS, and voyage and data optimisation. However, it also states that these changes alone are insufficient for the industry to decarbonise (European Commission 2023, p. 138). Moreover, the EU directive 2000/59/EC (2000) sets requirements for ports to have adequate facilities and capacity for waste handling, which is important to reduce the amount of waste and sewage disposed of at sea.

The article *"Responsible Cruise Tourism: Issues of Cruise Tourism and Sustainability"* brings out the Norwegian Cruise Line as a pioneer due to installing advanced wastewater treatment systems (AWTS) on all their ships by 2008, while the cruise line Royal Caribbean International still had almost half of its fleet without AWTS in 2010. Wastewater is differentiated into two different types: black water and grey water. Black water being solid human waste and waste from medical facilities, and grey water non-sewage wastewater that results from showers, dishwashing, laundry and such (Butt, 2007, p. 549). These systems help mitigate the impacts on marine life. Despite having installed AWTS, many ships disposed of untreated grey water as some of these water systems could not treat it, suggesting that the progress was not as significant as portrayed (Klein, 2011, p. 107). A different kind of cleansing technology is ballast water treatment. Ballast water is water the ships fill to keep the vessel stable (Norwegian Maritime Directorate, n.d.). It has been known for years that ballast water from ships carries microorganisms, animals and plants capable of harming the environment at their discharge destination. Finally, in 2016, it became required to install treatment systems for ballast water globally (NOU 2022:1, 2022).

The cruise tourism industry is focused on sustainability, and research on possible solutions is a hot topic. The answer to sustainably operating large ocean vessels is not simple — yet hopefully possible, as many of them sail the ocean daily, and the industry keeps growing.

2.5 Sustainability Model

Sustainable development is complex in a capitalistic society; as shown by

Figure 1, "*Degrees of Sustainability".* The ecocentric positions values all living things including their environment as the most important entity on our planet, while anthropocentrism, being the opposite, believes that human beings is the most important entity. Terms like economic de-growth are rarely used when looking positively at the future, but it is vital to keep reaching for lower resource usage and more sustainable business models that inevitably include anti-economic growth. The cruise ship sector is expected to increase by up to 250% by 2050 (Simonsen et al., 2019), while the EU has set the goal for climate neutrality by the same year (European Union, 2020). This shows that the industry has not planned for any economic decrease but rather the opposite, resulting in a dire need for advanced green technology.

EU Taxonomy declares that sustainable activities must contribute to one of the following environmental goals: reducing and preventing GHG emissions, climate adaptation, sustainable use and protection of water resources and marine resources, transition to a circular economy, waste prevention and recycling, prevention and control of pollution, or protection and restoration of natural diversity and ecosystems (Meld St. 13 (2021-2030), 2021, p. 182).

When answering our problem statement "Can cruise tourism be environmentally sustainable?", this model will be used to determine which sustainability position cruise tourism currently can be categorised within, then based on the results from the literature review, which sustainability position cruise tourism can obtain in the future. We consider regenerative tourism a best practice and thus see this as the alternative referring to a "very strong" position within the model with minimal resource usage and anti-economic growth.

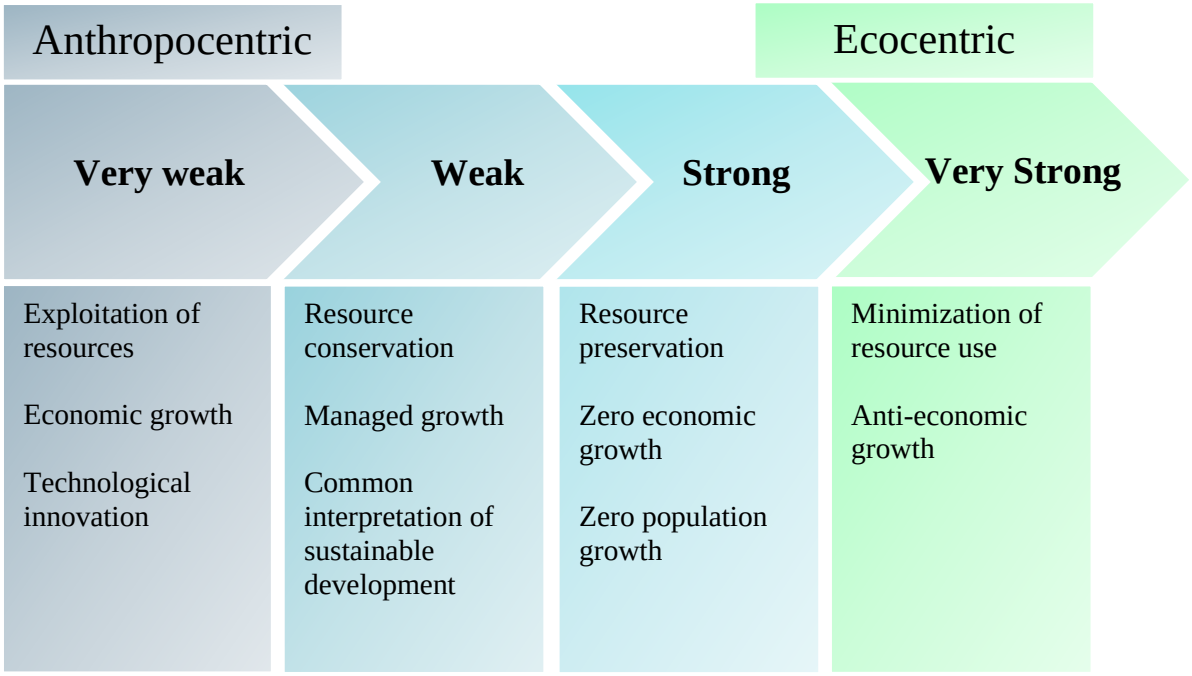

Figure 1: Degrees of Sustainability. (Page & Connell, 2020a, p. 412)

3 Methodology

3.1 Research Design and Justification

As stated initially, this paper seeks to investigate the research question “Can cruise tourism be environmentally sustainable?” and "How can Norway develop its cruise tourism sector within its national tourism strategy to enhance sustainable practices and meet its environmental goals?" by analysing published literature.

This chapter describes how the knowledge has been obtained and the process of ensuring that our research findings are scientific and valid. Firstly, we will briefly explain the scope and purpose of our research and present the justification for why we have chosen a literature-based approach. Then, the search strategy and data extraction description will be presented, followed by a quality appraisal and possible limitations of this thesis. Lastly, we will briefly discuss ethical considerations.

3.2 Data Sources and Search Strategy

3.2.1 Search Methods

As mentioned, we conducted a systematic literature search, and as such, a systematic search strategy was developed and carried out (Figure 2). We performed the literature search using the platforms and databases “Web of Science” (WoS), “Academic Search Premier” (ASP) and “Hospitality and Tourism Complete” (HTC). We believe that by conducting our systematic search in these databases, we will find and be able to include any relevant research within our topic and set time frame.

The initial search was conducted in the three databases on January 9, 2024. We used the following keywords: cruise tourism, cruise operators, cruise ship, cruise, sustainab*, responsi*, environment*, emission*, waste management, biofuel, air pollution, and onshore power. We chose to truncate four keywords so that any publications containing variations of these words would be included. We added more limitations and criteria to enhance the search quality and conducted a secondary search.

To further limit our selection, we conducted a third search with the limitation of searching for keywords in abstracts only. After removing duplicates and non-relevant abstracts, we manually evaluated the remaining selection to determine inclusion or exclusion. The inclusion and exclusion criteria applied were based on the research question, and therefore, we included articles which specifically focused on cruise tourism and the environmental impacts related to this. The inclusion and exclusion criteria are presented in detail in Table 1.

Table 1: Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Published between January 2013 and January 2024	Review Articles
Peer- reviewed	Studies focusing on economic or sociocultural impacts of cruise tourism
Publication in English	Studies focusing only on corporate, locals or visitor attitudes
Full-text available	Studies focusing on impacts of the COVID-19 pandemic
Studies with an experimental methodology	Technological development of cruise ship or port components
Studies focusing on environmental impacts of cruise tourism, in general or a specific sub-topic*	

**Relevant sub-topics: waste management, air pollution and emissions, water pollution, onshore power supply, biofuels, etc.*

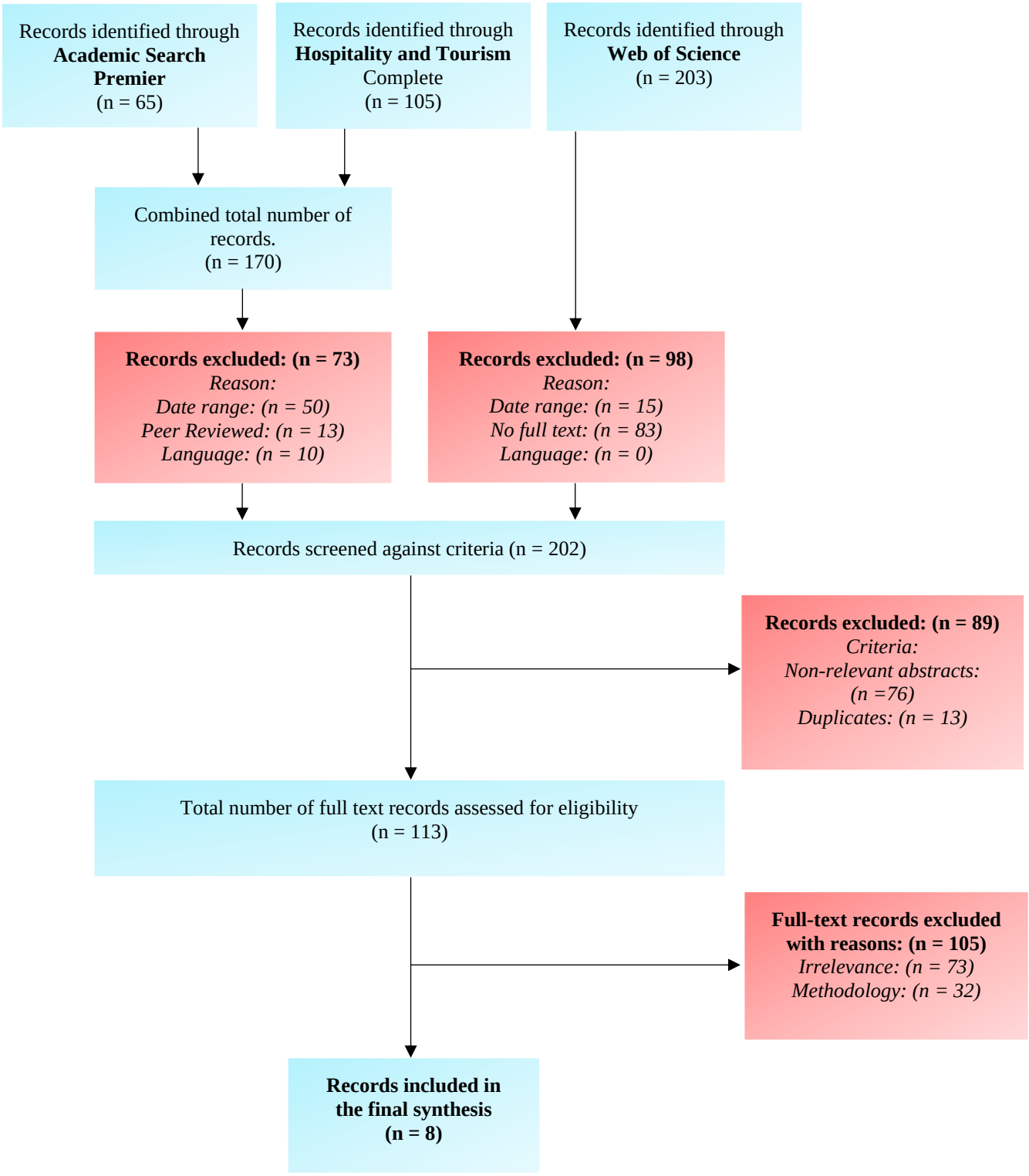

Figure 2. Flowchart of the search outcomes and the selection process.

3.2.2 Search Outcomes

The initial search provided 373 articles: 65 from ASP, 105 from HTC, and 203 from WoS. After applying the date range, 308 articles remained. The databases provided different filtering possibilities, so we could not apply the same filters in all three. Thus, the peer-reviewed criteria were only applied in the ASP and HTC databases, while the full-text filter was applied in WoS. This is clearly shown in Figure 2, where two separate boxes exist for the different database filtering procedures. Only articles in English were eligible, which was filtered for in all three databases. This left a selection of 202 articles, which were then screened for the appearance of relevant keywords in the abstract, conducted using the limitation tool incorporated in each database.

After removing records with non-relevant abstracts and duplicates that appeared in more than one database, 113 individual records remained. Finally, we conducted a new systematic assessment of the remaining articles, where we manually assessed the titles and, when necessary, the abstracts according to the research question and inclusion criteria. Based on this third screening, 73 articles were excluded based on irrelevance to the research question, and an additional 32 were excluded based on methodology. We reviewed the remaining eight articles in their entirety, and these constitute the final selection (presented in Table 2). Throughout the review process, both authors discussed the inclusion and exclusion of the articles.

3.3 Data Extraction and Synthesis

Braun and Clarke's thematic analysis (2006, p. 87) inspired the process of extracting data from our selected sources. Initially, we familiarised ourselves with the data and relevant literature. We then compiled a list of codes based on the themes identified in the scope of our literature search. Using a deductive approach, we started focusing on the three aspects of sustainability before narrowing it down to environmental impacts. From there, we defined four subtopics to which we categorised our findings.

We chose to manage the data using the software Zotero (*Zotero,* 2023), which allows both authors to annotate all materials efficiently throughout the research process. To ensure objectivity and prevent bias in the initial analysis, each author independently reviewed the eight selected articles before discussing the findings.

3.4 Quality Appraisal and Limitations

Systematic literature reviews present several challenges that may threaten the research's reliability and validity and thus must be considered. Limitations inherent in literature-based approaches can be publication bias, variation in study quality in the selected literature and gaps in existing literature. In addition, there may be limitations in the scope of the reviewed literature, which may affect the findings and limitations in the scope of the search (Lame, 2019). By being aware of the sources of error that the study design can present, it is easier to consider this in the planning and arrange for preventive measures in the implementation to reduce the likelihood of weakening the results.

It is important to consider publication bias when analysing articles which report statistically significant effects. It is more likely that studies that discovered an effect are published than those that did not, which might lead to an exaggerated importance of the effect (Lame, 2019). This is, however, more important in other sciences, such as health science, as the effects might have greater repercussions. Furthermore, the quality of the included studies must be evaluated. As mentioned in the quality appraisal, we have considered the quality of the selected studies in the screening process. This also includes accounting for the analysis done in the different studies and considering any conflict-of-interest authors might have had.

Regarding research gaps, it is evident that more studies on some topics than others are included. In our selection, we have three studies examining air pollution compared to one study concerning solid waste and wastewater management, one investigating OPS, one on biofuels, and two with a combination of subtopics. Drawing conclusions based on the findings of only a few studies within a topic might not reflect the whole picture of the challenges. However, we have tried to account for this narrow selection with a broader scope of search, as we have used various search terms and synonyms and truncation of terms to increase the possibility of finding a larger body of publications within each sub-topic. In addition, to reduce possible sources of error, we have adhered to the ethical guidelines of the National Committee for Research Ethics in the Social Sciences and the Humanities (NESH) (2022) and the guide to Internet research ethics ((NESH) 2019).

3.5 Ethical Considerations

This thesis does not collect personal data, so ethical considerations regarding participant privacy and other related issues have not been evaluated. However, with the recent emergence of artificial intelligence (AI) and machine learning, new ethical considerations arise. This must be considered when collecting, reading, and interpreting findings from the internet – especially when evaluating the reliability and accuracy of these records. In this study, the use of AI has strictly been to aid in formulating sentences and not in any part of analysing data or finding articles. We have only included peer-reviewed articles as our data basis and used official reports and other official documents in our theory section to ensure the validity and reliability of the content.

The mentioned software Zotero was used to ensure correct citation of references both in the text and the bibliography using APA 7 reference style. We have described all aspects of the process as accurately and sincerely as possible, especially concerning searching and selecting data and analysing and extracting the different findings. We recognise that there is a possibility that findings may have been interpreted in a slightly different nuance than the original author intended. Still, to the best of our ability, we have presented all findings comprehensively and honestly.

4 Analysis

The eight studies are presented in Table 2, where they have been assigned their unique number for reference throughout the following analysis, in which we proceed to discuss them. This arrangement allows the reader to get an organised overview of the findings before reading about them. We have chosen to discuss the results consecutively in relation to the theory from the literature review chapter. Each subtopic will first discuss the environmental impact in relation to our primary problem statement:

"Can cruise tourism be environmentally sustainable?"

Following this, we will conclude each section by narrowing down to Norwegian operations and the national reports, strategies and legislations, in order to answer the secondary problem statement:

"How can Norway develop its cruise tourism sector within its national tourism strategy to enhance sustainable practices and meet its environmental goals?"

The eight included studies have all evaluated the environmental impacts of cruise tourism. We have divided the impacts into four subcategories: air pollution, biofuels, onshore power supply, and waste and wastewater management. Three of the studies examined air pollution and emissions (number 3, 4 and 8), study 1 examined waste management, study 2 examined biofuels, and study 6 examined onshore power supply. Studies 5 and 7 examined a combination of subtopics.

As CO_2 emissions often are the measurement of environmental sustainability, it was not a surprise that three of the included studies specifically analysed this. However, as mentioned, environmental impacts can be many other elements, and often impacts that are harder to measure than the release of GHGs. Considering this, it is worth mentioning that the four subtopics do not cover all possible environmental impacts of cruise tourism, as our thesis is based on findings by other researchers. Impacts such as effects on wildlife, movement of algae and microorganisms due to discharge of ballast water, water usage, light and noise pollution, and coral reef disturbances are subjects that are not taken into consideration in this literature review, merely because it was not a part of the studies found in our search. We do acknowledge that these should also be considered to reach a more comprehensive understanding of environmental impacts.

Table 2. Descriptive information from the included studies and the main findings.

Ref. no., authors, year	Title	Methodology	Scope and Purpose	Findings	Conclusion
1. Svaetichin & Inkinen, (2017)	Port **waste management** in the Baltic Sea area: A four-port study on the legal requirements, processes, and collaboration.	Qualitative interviews of 12 executives responsible for environmental issues within four selected ports in the Baltic Region.	Analysing the quantities and handling of cruise-generated waste in four Baltic Sea ports and investigating if collaboration could improve special-waste management.	• Need for standardised environmental legislation to develop coherent measurement systems. • Ports should handle specific types of waste and collaborate as a spatial network. • The distribution of waste streams among the studied ports is uneven.	• Unified legislation would diminish measurement and procedure variation. • Three studied ports provide economic incentives for vessels following their guidelines. • The different ports have different specialisations in their waste handling management. • Collaboration between various specialised ports will result in better waste handling management and, thus, a better environment.
2. Humpe, Sun & Gössling, (2019)	Cruise **emissions** and economic feasibility of **biofuels.**	Calculated the cost of switching to alternative fuels using the fuel profile of Carnival Corporation and 2019 average fuel prices.	Estimated the cruise sector's emissions and profitability changes related to low-carbon biofuels, per trip and in total.	• 99% of emissions are passenger related. • A 100% replacement of current fuel with biofuel raises the fuel cost ratio by 11% while reducing the profit ratio from 15% to 4%. • Fuel cost will be 2.5 times higher than baseline and will be the largest operational cost.	• Cruises, in combination with flights, must be considered one of the most environmentally harmful forms of mass tourism. • Flags of convenience make it hard to establish obligations to use alternative fuels. • Ports can play an important role in reducing GHG emissions by implementing market-based instruments that make fuel switching attractive.
3. Simonsen, Gössling & Walnum, (2019)	Cruise ship **emissions** in Norwegian waters: A geographical analysis.	Calculation and modelling of GHG emissions from cruise ships based on location data from 2017.	To model the amount of CO_2, NO_x and $PM_{2.5}$ emissions.at sea and in port in Norwegian waters. Evaluate the effectiveness of port-specific policies.	• 81 cruise ships of various sizes emitted 0.4 Mt of CO_2, ~7200 t of NO_x and 132 t $Pm_{2.5}$ while consuming ~129,800t of fuel in Norwegian waters in 2017, distributed over 549 trips. • 14.6% of the pollutants are emitted in ports, where Bergen, Oslo, and Stavanger receive most, followed by Geiranger and Flåm.	• A speed reduction of 2 knots would significantly reduce emissions and fuel consumption by ~16%. • Medium-sized ships (gross tonnage = 60,000-80,000 GT) appear more efficient than larger ships. • High emissions in both absolute and relative terms (per berth) • Predicted growth illustrates the need for national legislation.
4. Ruiz-Guerra, Molina-Moreno, Cortés-García, & Núñez-Cacho, (2019)	Prediction of the impact on **air quality** of the cities receiving cruise tourism: The case of the Port of Barcelona.	Data collected monthly from 2006 to 2017 with automatic analysers for gaseous pollutants. The emissions data is compared to data on passenger numbers.	Analyse the relationship between air quality and volume of cruise passengers and develop an index for predicting air pollution.	• Observes a linear relationship between the number of passengers in the port and the air pollution in the port city. • Formulate a predictive equation for the Environmental Index based on the number of passengers expected. • Create a sustainability model for the cruise industry.	• Developing technological systems could help determine each ship's emissions precisely. • Cruise ships should report their CO_2 footprint to each passenger.
5. Olaniyi, Prause, Gerasimova & Inkinen, (2022).	**Clean cruise shipping**: Experience from the BSR.	Calculations based on empirical data collected from the industry, observations, and expert interviews.	Calculates the environmental costs based on cruise shipping's CO_2 emissions to evaluate the industry's progress toward cleaner operations in the Baltic Sea.	• Total cruise shipping emissions equals 470,000 t CO_2 (on the guest level), or 590 kg CO_2 per 7-day trip. This equals 84 kg per day per guest. • Total fuel costs for a 7-day cruise are 148 million USD. • The baseline scenario with MGO fuel, diesel buses for excursions, and 60km of goods logistics has the highest CO_2 emissions and the lowest costs. • LGN and OPS-powered cruises with electric buses and local supply of goods have the lowest emissions but double the cost. • Use of OPS reduces in-port emissions by 25%. • Per 1000 USD invested in reduction measures, there is a reduction of 573 kg CO_2. These calculations yield an increase of 5% (60 USD) in the ticket price of a 7-day cruise, which gives a 30% reduction in CO_2.	• The most carbon-efficient options are the most cost-intensive for both cruise lines and passengers. • LNG-propelled cruise ships that connect to OPS, use electric buses for excursions and use local sources to supply goods emit ~161 t less CO_2 than baseline operations. • The 25% reduction in emissions through OPS is important for coastal areas and smaller destinations with low populations compared to the number of incoming tourists. • OPS infrastructure must be powered by renewable energy to achieve the reduction. • Findings show that an increase in tourism is equally proportionate to an increase in waste generation.

Ref. no., authors, year	Title	Methodology	Scope and Purpose	Findings	Conclusion
6. Kizielewicz, J. (2023).	Environmentally friendly cruise seaports in Northern Europe – **onshore power supply**.	Surveys using CASI (Computer-Assisted Self Interviewing) and EMS (Electronic Mail Survey). Nine ports participated out of 32 invited.	Assess the Northern European seaports' involvement in preparation of OPS infrastructure enabling cruise ships to connect while moored.	• Northern European ports are planning investments to increase energy efficiency. • The majority of ports have OPS for smaller vessels but do not plan investments in higher capacity OPS due to economy. • Only five ports in Northern Europe have OPS available for giant cruise ships. • The high cost of OPS maintenance discourages ports from investing.	• Seaport authorities know the advantages of investing in OPS systems, yet the investments are cost-intensive and thus need public co-financing. • The shipowners facilitate the installation of solutions for OPS in new ships and the upgrading of old ones. However, this does not help enough, as the infrastructure in the ports is lacking.
7. Wang & Chambers, (2023).	**Environmental Compliance** and Practices of Cruise Ships in Ísafjörður, Iceland.	Exploratory case study. In-person guided survey. N = 40 (of 46 ships) that visited the port in May-September 2019.	Assessed the compliance between laws and practices on waste handling, emissions, oil, wastewater and ballast water from cruise ships in the port of Ísafjörður.	• 2 of 40 ships used above 2% sulphur content fuel in territorial water. • None of the vessels used alternative fuels other than marine fuel oil. • 7 of 40 had shore power systems onboard, but the port did not provide shore power. • 12 of 40 ships discharged waste oil to shore facilities. • 28 of 40 ships chose to discharge the treated waste oil overboard. • Estimated grey water discharged illegally into Icelandic waters in the summer of 2019 is approximately 625 m^3 per day. • Two ships violated regulations and dumped 213m^3 of unclean ballast water in the jurisdiction of Iceland.	• There is no clear trend in violations and the ship's age. • Many participants had difficulties understanding the Icelandic rules correctly. • None of the interviewees were able to explain the rules of wastewater. The state should be responsible for ensuring the law's accessibility. • Inconsistency between online information and regulations may cause misleading information and unnecessary pollution. • It is crucial that Iceland organise a consistent standard and systematic framework of inspections.
8. Gössling, Humpe & Sun, (2024).	On track to **net-zero**? Large tourism enterprises and climate change.	Study on large tourism enterprises based on annual reports. Total n=29. Specifically, cruise companies n=2.	Calculations on the interrelationship between greenhouse gas emissions and revenue in large tourism enterprises.	• Carnival and Royal Caribbean emitted 15.6 million tonnes of CO_2 in 2019. • Per passenger emissions for an average cruise (7,2 days) have declined from 913 kg CO_2 (2015) to 804 kg CO_2 (2019). • Absolute emissions have not declined. • When combining cruise and air travel, the average cruise is even more emission-intense, adding about 120 kg CO_2 per 1,000 km distance. • Estimated that Carnival and Royal Caribbean will grow to emit 70.9 million tonnes of CO_2 and revenue of 50.5 billion USD in 2050. • Growth cannot be aligned with net-zero goals.	• While companies show annual progress in improving emission intensities, overall emissions continue to grow. • None of the sectors in the study are on track to net zero. This illustrates that the continued growth in tourism cannot be aligned with the steep emission reductions necessary to reach the goal of net zero by 2050. • Because of this, new business models need to be developed. All tourism firms are obligated to reduce their emissions. • High inflation rates may suggest that a business is decarbonising more than it actually is when numbers on emissions are presented "per revenue". • Large tourism firms must consider far-reaching operational changes to reduce emissions while maintaining revenue. • Market-based instruments such as carbon taxes and other policies will be necessary to bring down emissions.

4.1 Air Pollution

Identified as the one of the most significant climate impacts of cruising, air pollution might also be the most obvious (Transport & Environment, 2023). Study 4 (Ruiz-Guerra et al., 2019) investigated the relationship between the number of cruise passengers and emissions in the port of Barcelona. The authors analysed data on monthly emissions and found a significant correlation between passenger volume and air quality. The findings of study 4 correlate with those of study 3 (Simonsen et al., 2019). Study 3 modelled the amount of emissions (specifically CO_2, NO_x and particulate matter [$PM_{2.5}$]) by cruise ships at sea and in port in Norwegian waters throughout 2017. Their findings showed that larger ships, which typically carry more passengers, tend to have higher emissions in absolute terms and per berth kilometre. Since cruises might hold a certain amount of vacancy, they based their calculations on number of berths, creating a "best case" scenario as the calculations divide the emissions on the maximum possible number of passengers. The findings of both studies indicate that increased cruise activity directly contributes to higher emissions. Calculations in study 3 estimated that 14.6% of the fuel burned, corresponding to 60.7 tonnes CO_2, 1 tonne NO_x and 19.1 tonnes $PM_{2.5}$, was in-port emissions. The ports of Bergen, Stavanger, Oslo, Flåm and Geiranger experience the highest emissions levels. Flåm and Geiranger are located within the World Heritage fjords, and Geiranger, which holds only 226 inhabitants (Thornæs, 2023), was exposed to 15.9 kg of $PM_{2.5}$ per person.

The European Commission aims for climate neutrality by 2050 (European Union, 2020), requiring significant operational changes across multiple industries. Study 8 (Gössling et al., 2024) analysed emissions from major cruise, aviation and hotel companies, categorised by direct, indirect, and upstream/downstream emissions. Focusing on two of the largest cruise lines, Carnival and Royal Caribbean Cruises, they calculated projected emissions based on four scenarios ("business as usual" and sectoral emissions reduction by 90%, 95% and 99% in 2050). Under current growth trends, the two firms are projected to produce 70.9 million tonnes of CO_2 and 311.6 billion USD in revenue by 2050, directly contradicting the net zero objectives. According to their calculations, achieving a 99% reduction in emissions by 2050 would require a 20% yearly efficiency improvement, which they consider unrealistic and unattainable (2024, p. 24). The researchers suggest that absolute emissions will continue to rise unless there is an immediate shift towards de-growth or enhanced qualitative development. Norway has stated a vision for tourism aiming to be more regenerative (NOU 2023:10, 2023, p. 10), and thus de-

growth should be positioned as a strategic move for cruise tourism. However, CLIA forecasts up to 29% growth within 2028 compared to 2022 capacity (2023, p. 6), which completely conflicts with both study 8's recommendations and the stated contributions of the global shipping sector under the Paris Agreement (CAN & CSC, 2018; UNFCCC, 2015).

Study 8 additionally recommends that ports implement carbon efficiency ratings and proportional carbon taxes in order to incentivise reductions in carbon output (2024, p. 10). However, this still raises the problematic question of other GHG emissions, such as methane. With the goal of reducing GHG emissions, legislation and strategies are looking to reduce the emissions of primarily CO_2. The industry is consequently looking towards liquified natural gas (LNG) for a solution to meet such emissions targets, and CLIA reports that 60% of all ships produced in the coming 4 years will rely on LNG as primary energy source (2023). Notwithstanding the fact that LNG emits lower levels of CO_2, and thus reducing GHG emissions, it emits methane which has a global warming potential over 80 times that of CO_2 (Transport & Environment, 2023, p. 4). It is concerning, given the escalating crisis of global warming, that cruises prefer to emit a GHG that much more potent than CO_2, even though it may result in lower overall air pollution. The Norwegian Coastal Administration sees this mainly as a transitional solution, as it is possible for engines running on LNG to run on biofuels or liquified biogas (LBG) (DNV, 2021).

There are other possible methods suggested, and some already implemented, to mitigate air pollution, and all three studies (3, 4 & 8) agree that cruise ship emissions significantly impact air quality due to CO_2, NO_x and $PM_{2.5}$ pollution. These pollutants have been proven harmful to the environment and public health. An often-used solution counteracting air pollution today is a "scrubber", an exhaust gas cleaning system that can be fitted to the cruise ship to remove SO_x in the exhaust by spraying it with water. The open-loop type is mostly used, meaning that the seawater used to clean the exhaust is discharged back into the sea, with the pollutants entering the ocean instead of the air, thus creating a whole new pollution situation (Transport & Environment, 2023, p. 10). As air pollutants are more commonly regulated, unlike pollutants in the sea, the operators avoid contravening the regulations while still emitting the same amount of pollutants.

Study 3 argue that for Norway's goal of becoming a leading cruise destination in reducing environmental impacts of the sector, it is essential to assess the distribution of pollutant loads

between ports, between ports and sea and overall totals. This assessment will make designing workable policies and legislation addressing air pollution easier. The authors highlight some assumptions made in the calculation of data, resulting in what might be an underestimation of pollution levels in the model, thus advocating that the actual pollution levels may be higher. Consequently, only international cruise ship emissions are included, leaving Hurtigruten and other ferries out of these calculations. By adhering to the Norwegian Climate Action Plan (2023) and the zero emissions proposal (2023), and incorporating both Hurtigruten and all passenger ships into the emissions calculations, one can reasonably infer that the actual emissions are significantly higher.

The authors of study 4 developed a predictive equation for monthly environmental impacts based on cruise tourism forecasts, enabling proactive pollution management. Additionally, proposing a sustainability model that other host cities can use to mitigate the environmental impacts of cruise industry air pollution, and advocate for technological advancements and innovation to lower emissions. Further, they suggest that cruise ships report individual CO_2 footprints to enhance tourist awareness, similar to other transport modes. The study concludes with a call for the industry to innovate and for ports to improve air quality measurements to accurately assess each ship's emissions and be able to introduce penalty fees (Ruiz-Guerra et al., 2019, pp. 19–20). If Norwegian ports utilise this predictive equation, they could add forecasted calls of all passenger ships and predict the level of pollution, and thus introduce predictive measures in ports where the pollution levels are greatest.

Another solution might be to look to the city of Venice's approach: being the most polluted city port from cruise ship emissions in 2019, they have since taken a stand and prohibited cruise ships above 25,000 gross tonnes (GT) from entering Venetian Waters from 2021. The ban has caused air pollution levels to drop by 80% within 2022, according to Transport & Environment (2023, p. 19). Study 3 found that 31% of the ships in Norwegian waters were within the up to 25,000 GT category, and 80% of those were built before 2000. This was also the category with the lowest emission levels of CO_2, NO_x and $PM_{2.5}$, both in total and per nautical mile, but not per berth-km (Simonsen et al., 2019, p. 92). When considering fuel use efficiency and calculation per berth-km, ships in the 60,000 to 80,000 GT category appeared more efficient. Additionally, the findings showed that a modest speed reduction of approximately 2 knots for all size classes would significantly reduce emissions and fuel consumption by 16%. This

correlates to the conclusions of CAN & CSC (2018, p. 3) stating that a 30% speed reduction by half the shipping sector could save 2 GT of CO_2 until 2030.

If further research is conducted on this topic, one could calculate and discuss "optimal" ship size and speed (2019, p. 95), which would prove valuable for all stakeholders. Cruise lines could optimise specific fuel use, destinations would experience less pollution, and ports would face better in-port power supply and infrastructure opportunities. Introducing such measures will make a difference for particularly vulnerable destinations such as the World Heritage fjords. However, it would be reasonable to consider making these into national guidelines, as the analysis by Menon Economics predicts that introducing legislation in a restricted geographical area will cause marine traffic to relocate to other places (Handberg et al., 2022).

4.2 Biofuels

Study 2 (Humpe et al., 2023) investigated the global emissions and the fuel cost ratio of replacing current fuels with biofuels. The calculations were based on annual report data from 2019 for the three largest cruise lines. They calculated emissions from the passenger market (scopes 1 & 2) and the added effect of the sector's ancillary services, such as transporting goods and services, employee commuting and waste generation (scope 3). These values were broken down into per-passenger and trip values. Their findings show that the average trip length in 2019 was 7.2 days, where the average emissions totalled 119 kg CO_2 per passenger day, which amounted to 827 kg CO_2 per trip (scopes 1 & 2), or 1.65 tonnes CO_2, including scope 3 emissions. A flight to the port would add 270 kg CO_2 per 1000 km of air travel. These calculations are somewhat higher than those reported in study 5 (Olaniyi et al., 2022, p. 9), totalling 84 kg CO_2 per day, and 590 kg per 7-day trip. Based on the calculations in study 2, findings underlined that considering the historical yearly growth of the sector of 6.6% with efficiency gains of 2% per year, this would imply 40 million passengers in 2030, causing emissions of 30 Mt CO_2 (scopes 1 & 2) or 59 Mt CO_2 including scope 3 emissions, which again contradicts global ambitions of a 50% reduction of emissions by 2030 (CAN & CSC, 2018; Humpe et al., 2023, p. 2).

Study 2 also found that a 100% replacement of current fuels with alternative biofuels (biofuel, sulphur fuel oil, marine gas oil, LNG) would raise the fuel cost ratio from 7% (baseline) to 18% of the total revenue. At the same time, the profit ratio would reduce from 15% to 4%. In this

scenario, fuel would cost 2.5 times more than the 2019 baseline and become the highest operational cost, which also corresponds to the findings in study 5 (Olaniyi et al., 2022, p. 11). These costs do not include refitting current vessels to accommodate alternative fuels or constructing new vessels with updated technology. To keep the profit ratio larger than the fuel cost, the cruise lines would have to limit the replacement to below 40% of the total fuel usage (2023, p. 3). The authors argue that it seems acceptable to internalise the costs and reduce profitability as the sector pays minimal income taxes while imposing massive negative environmental effects. Furthermore, they advocate a need to force the sector into adopting low-emission fuels, as the current efforts are insufficient to reduce emissions, which is also stated in the 2023 IMO strategy (IMO, 2023, p. 8). Here, they highlight the ports' key position in reducing emissions by introducing market-based instruments to make it attractive for shipowners to switch fuel. The article also questions whether alternative fuels can be available at scale and advocates for further research (Humpe et al., 2023, pp. 3–4).

From the proposed implementation of zero-emission requirements in the World Heritage fjords, the Norwegian Maritime Authority suggests the usage of biofuels as a step in the transitional stage of becoming emission-free. However, should the industry only replace 40% of the fuel with biofuel to keep the profit greater than the costs, this will not be enough to reduce GHG emissions to a level that allows them to sail in the World Heritage fjords in line with the consultation proposal. Reducing cruise operators' profits from 15% to 4% will be an economic drawback to the industry, and, it is already expected to be a fall in cruise ship passengers to Geiranger and Flåm (Handberg et al., 2022, p. 38; Norwegian Maritime Authority, 2023, p. 5). Consequently, a reduction in cruise operations is probable to cause a fall in revenue, value creation and employment within the tourism industry in these areas (Norwegian Maritime Authority, 2023).

Furthermore, it is questioned whether the infrastructure can supply enough biofuel to the cruise ships. Maritim 21 (NOU 2022:1, 2022) reported that only a few ports in Norway offered biofuels in 2022, and therefore, some adaptation needs to be made to improve access to biofuels. CLIA reports that ships that rely on LNG can be converted to run on biofuels (2023, p. 12), which underpins the likelihood of cruise ships to run on biofuels in Norwegian fjords in the coming years. By implementing the zero-emission requirement in the World Heritage fjords, Norway is proceeding in the direction suggested in study 2 (2023), as they highlight the necessity of forcing the sector into reducing their emissions.

4.3 Onshore Power Supply

Study 5 (Olaniyi et al., 2022, p. 11) integrated economic and environmental assessments by examining the annual CO_2 emissions and the associated emission costs of a 7-day cruise in the Baltic Sea Region. The authors constructed 24 different scenarios for cruise ships' propelling and energy supply. They calculated the baseline values to ~472,000 tonnes of CO_2 and a total cost of around 228 million USD. They found that scenarios with the lowest emission included LNG-fuelled vessels connected to the OPS systems. However, these scenarios nearly doubled the costs (2022, pp. 10–11). A regression analysis on costs and emission reduction showed that for each 1000 USD invested in reduction, there would be a decrease of 573 kg CO_2, yielding a 5% (60 USD) increase in the ticket price and a CO_2 reduction of 30% for an average 7-day cruise. Furthermore, they also found that connecting cruise ships to OPS while moored significantly reduces the vessel's in-port CO_2 emissions by 25%. However, it is important to note that this reduction is only true if the OPS system is powered by renewable energy sources (European Commission, 2023, p. 138).

Study 6 (Kizielewicz, 2023) assessed the preparation and involvement in infrastructure development, enabling a connection between cruise ships and OPS systems in Northern Europe. Their findings show that only a few ports in Northern Europe offer shoreside energy connections for cruise ships, while significantly more offer connections for ferries and smaller vessels (2023, p. 359). According to the article, the cruise-compatible installations are in Stockholm, Gothenburg, Gdynia, Kristiansand, and Oslo. It is unclear whether all these ports have responded to the survey and thus have been included, as CLIA reports several more ports with such installations. In the CLIA report, Norway seems to have the most active OPS ports (n = 9), with four more already funded and an additional two planned (CLIA, 2023, p. 15). This gives a somewhat distorted picture of reality, as official Norwegian documents show that only the ports of Bergen, Kristiansand, Flåm and Haugesund have OPS facilities for cruise ships. In contrast, the other five are suitable for other types of vessels, or the cruise ships moored there have not suitable technology to connect (DNV, 2021, p. 41; Jørgensen, 2020; NOU 2023:10, 2023).

The authors of study 6 further emphasise the challenges of adapting existing infrastructure to increasingly larger vessels and accommodating various onboard power systems across cruise vessels and lines. The findings showed that actions and plans favouring OPS installations are

taken in an increasing number of seaports in Northern Europe and that the port authorities are aware of the advantages of such investments. However, investments in this domain are cost-intensive, and thus, primarily popular year-round ports are planning to make them. Public co-financing has also been considered a solution since pollution reduction is a matter of public interest (Kizielewicz, 2023, p. 362).

Given that the electricity used in Norway mainly comes from renewable energy sources (NVE, 2024), the 25% reduction of in-port CO_2 emissions through use of OPS would be true in Norwegian ports. However, due to dryer weather and increased electricity consumption at the time of writing, Norway is facing an energy crisis, causing the southern parts of the country to have much more expensive electricity than the north (Milne, 2022). One can then question if the country currently has the appropriate infrastructure to supply onshore power to all cruise ships in all ports if there are already problems with the electricity supply. Further, the EU Commission report "Good Practices For Sustainable Cruise Tourism" (2023) points to standardisation for onboard connections to OPS to make it available to all vessels. Norwegian ports utilise the voltage level of the Norwegian power grid of 50 Hz, whilst most international ships use 60 Hz. This, in addition to various onboard infrastructures across vessels, further complicates the work on developing standardisation of connecting infrastructure. The consultation on zero emissions suggests that all passenger ships are required to connect to OPS systems when moored. However, it fails to propose solutions for how these requirements are to be carried out for either ports or ships (NOU 2023:10, 2023, pp. 9 & 139).

4.4 Waste and Wastewater Management

Waste handling management systems in four Baltic Sea ports, specifically focusing on legal requirements, processes, and collaboration, were examined in study 1 (Svaetichin & Inkinen, 2017). After interviewing 12 executives and professionals responsible for environmental issues and decision-making, they found that ports should specialise in specific types of waste and collaborate closer in networks. This would be both cost-effective and more sustainable as adequate reception facilities for all types of waste would not be needed in every port within a close vicinity. Additionally, their findings illustrated a desire for standardised environmental legislation and procedures, which would enable similar measurement systems and, in turn, enhance environmental protection and maintain competitiveness on an equal basis (2017, pp. 10–12).

Study 7 (Wang & Chambers, 2023), conducted in Iceland at the port of Ísafjörður, interviewed seafarers from 40 cruise ships about their emissions, oil usage, wastewater and ballast water treatment, and waste management. The study covered 90% of the calls that visited the port during the study period. Interviews showed that only 8% of the ships dispose of their waste in the port of Ísafjörður, and only one ship could differentiate its waste into recyclable categories. One argument was that ships had longer turnaround times in ports such as Reykjavík and, therefore, chose to discharge their waste there. None of the vessels used alternative fuel, only marine fuel oil. Even though seven ships had the systems to connect to shore power, Ísafjörður port did not offer OPS, which illustrates that it is not sufficient that only the cruise ships adapt. The ports also need to update their infrastructures in order to be able to utilise the full potential of new technology.

Nearly 75% of the ships investigated discharged treated waste oil overboard. With less than 15 parts oil per million parts water, their discharge was within MARPOL's restrictions. Surprisingly, the survey uncovered that none of the respondents were aware of the Icelandic wastewater regulations; 6 of the ships violated these regulations by discharging untreated wastewater within 12 nautical miles of the coastal line. Based on the data, the study calculated the total amount of grey water discharged illegally to approximately 625,000 litres per day by the cruise ships interviewed. Two ships violated ballast water regulations for discharge in Icelandic waters and dumped 213,000 litres of unclean ballast water into the sea. The authors found inconsistency in the information provided to the interviewees about the regulations and the actual Icelandic regulations. This clearly caused misunderstandings about what was allowed and what was not. To conclude, it was expressed a need for closer monitoring by the Icelandic government on the ships at port (2023, p. 245). Precise and easy access to local laws also seems to be a problem. Only by making laws and regulations accessible to key crew members is it possible that some of the violations would never have happened.

The challenges and issues related to cruise traffic in the Baltic Sea can be compared to those of the World Heritage fjords, as both are sensitive areas. Both areas face similar challenges related to the lack of tides compared to the open sea, which consequently means that harmful substances dumped in the sea will remain there for a long time. Annexe V of MARPOL regulates garbage pollution and prohibits waste from being discharged into the sea (IMO, 1978). Furthermore, according to the EU Directive 2000/59/EC (2000), ports must offer adequate

facilities to cope with the volume of waste from visiting ships. This means that every port needs to facilitate proper waste handling for all types of waste and sewage.

The findings in Ísafjörður are likely to pose a picture of typical operations in European waters. The dumping of solid waste and wastewater into the fjords can affect the maritime environment via microorganisms, animal life, and other life forms that inhabit the sea. Food waste can lead to a higher demand for biological oxygen and total organic carbon and affect the water quality, thus negatively affecting marine life. An increase in cloudiness of the water and elevated nutrients can cause harm to the fish's digestion and health. In addition to all of the above, the accidental release of plastics is a prominent issue (Klein, 2011, p. 110).

These findings indicate that ports can specialise in different types of waste and accept more of one type than another, as it is better for the environment and more cost-efficient. Official reports and information about onshore facilities in Norway and their waste handling are hard to find, and therefore, it is difficult to discuss the specifics of waste management in this review. Norwegian legislation on the subject refers to MARPOL rules (Regulation on environmental safety for ships etc., 2012). The Pollution Act §20-5 refers to the receiving party and that they are obliged to make it possible for waste from ships to be collected and sorted to facilitate reuse and material recycling (The Pollution Act, 1981). This shows that Norway has some regulations on the subject. Our research is missing data from Norwegian land facilities on whether they implement it and how closely the Norwegian Maritime Authorities control the operations. As cruise ships represent a quarter of all waste created by the merchant fleet, it is pressing to process their waste in a circular manner in order to mitigate pollution by it (Butt, 2007).

5 Conclusion

This study has examined the environmental impacts of cruise operations and issues faced in the process of developing a more sustainable sector. The objectives were to bring a comprehensive understanding of opportunities and challenges in today's industry. Moreover, we have identified present practices and technological advancements that contribute to pushing the sector closer to environmental sustainability, in order to answer the two problem statements; *"Can cruise tourism be environmentally sustainable?" and "How can Norway develop its cruise tourism sector within its national tourism strategy to enhance sustainable practices and meet its environmental goals?".* The findings create an evidence-based premise for the following recommendations for Norwegian legislative assemblies relevant to their decision-making processes.

One of the most concerning findings of this thesis was that even though green technology is advancing and put into practice, cruise ships emissions are continuously increasing, causing pollution growth incompatible with net-zero goals (Gössling et al., 2024). Several studies (2, 3 and 4) reverberate similar conclusions; cruises are considered the most environmentally harmful form of mass tourism, where 14,6% of the pollutants are emitted in ports, and it is observed a linear relationship between the number of cruise ship passengers and air pollution in the port city (Humpe et al., 2023; Ruiz-Guerra et al., 2019; Simonsen et al., 2019). OPS and biofuels are being explored as potential solutions, yet they impose significant financial costs on ports and shipowners. In addition, the most effective carbon-reducing solutions are also the most cost demanding. Moreover, the inadequate infrastructure for OPS hinders optimal functionality (Kizielewicz, 2023; Olaniyi et al., 2022).

Examining the findings within the EU framework and Norwegian objectives and policies, it is prominent to question the apparent contradictions. While research suggests continued growth within the cruise industry, accompanied by escalating emissions in the absence of adequate environmental mitigation technologies, strategic directives demand the achievement of emissions neutrality by 2050 (European Union, 2020; Gössling et al., 2024). The NOU "Live and Experience" (2023) advocates for regenerative tourism as a best practice option for all tourism sectors. However, the term remains an unknown concept in everyday language, and the reports from the industry itself show no signs of aligning themselves with a regenerative business model (CLIA, 2020, 2023). Addressing our initial research question of whether cruise

tourism can become environmentally sustainable, our findings indicate a misalignment with sustainable principles. Moreover, technological advancements fall behind the industry's exponential growth trajectory, leading to the inevitable conclusion that environmental sustainability in cruise tourism, with current technological capabilities, appears unattainable.

Menon Economics' analysis on the Norwegian fjords concluded that the zero-emission mandate in the World Heritage fjords will effectively be futile unless similar standards are applied to the entire Norwegian coastline. As local inhabitants in especially Geiranger and Flåm regard current cruise operations as invasive, the regulations are expected to reduce CO_2 emissions and potentially attract more residents to the area as cruise traffic likely will relocate (Handberg et al., 2022).

This brings us to our secondary problem statement: *How can Norway develop its cruise tourism sector within its national tourism strategy to enhance sustainable practices and meet its environmental goals?* Our analysis suggests that cruise tourism, in its current form, is unlikely to become sustainable and should, therefore, not be included in such a strategy. However, it is also unrealistic to expect Norwegian legislative assemblies to ban an industry that contributes significantly to the nation's economy. If Norway is to continue with this mass tourism sector in the future, it will require regulations to limit negative impacts and mechanisms to enforce them. Implementing these measures could lead to a more sustainable and environmentally responsible cruise sector, which would benefit both the industry and the nation.

First and foremost, it is imperative to implement zero-emission mandates across all Norwegian fjords, applying to all passenger vessels capable of carrying 12 or more individuals. Such mandates are essential for reducing emissions and preserving natural ecosystems for future generations. One immediately actionable strategy is to demand cruise ships to reduce sailing speed, as this has proven highly effective and does not require new investments in technology for ships or ports. Moreover, OPS systems should be internationally standardised and made a prerequisite for both ports and ships to fully utilise the available potential to limit fuel consumption, provided that there is enough available electricity from renewable sources. An additional property that should be made to Norwegian harbours is the infrastructure to facilitate availability of biofuels, although the national scale availability of biofuels is beyond Norway's control. It has become clear that the need for cooperation between ports is of the essence for cruise ship traffic to achieve a green transition. An area that could be an object of cooperation

is waste management and recycling, as it has been observed that specialisation in specific kinds of waste leads to more cost-efficient and environmentally friendly handling of waste. Therefore, the Norwegian ports should cooperate to enable the Norwegian coast to furnish a comprehensive solution for collecting and recycling waste generated by cruise ships.

Lastly, it cannot be emphasised enough that without standardisation of practices and responsibility for enforcement to follow up on all the measures, the measures will not have the desired effect of reducing environmental impacts.

5.1 Sustainability model

As concluded above, cruise tourism today would be positioned in *"Degrees of Sustainability"* (

Figure 1) as "very weak" because of its projected sectoral growth. According to the analysis of the researched studies, cruise tourism cannot achieve a "very strong" sustainability position, as this is defined as something with minimising resource use and anti-economic growth. Cruise tourism cannot achieve a strong ecocentric position, as long as it chooses to prioritize people's leisure time before encroachment on nature. CLIA's (2023) numbers on increasing cruise activity clearly illustrates that the industry is not seeking to mitigate and reduce economic growth in order to prioritise the environment.

As for the future of the cruise industry, the result from this analysis suggests that it will not be able to obtain a "very strong" sustainability position with the use of today's available technology. Should the cruises, with new innovations, accomplish to become emission-free, there are still issues left in the sector, such as water usage, mobilities of microorganisms through ballast water, emissions from production and other impacts from the cruise ship life cycle (Johnson, 2002). It is important to remember that the impacts caused by cruise tourism are not limited to the emissions made by the cruise vessels during operations but contain all impacts made by the vessel's complete life cycle. In order to obtain a "very strong" sustainability position, the cruise industry would have to adopt a degrowing-business model with a primary focus on environment precedingly of economy.

To conclude, cruise tourism can acquire a "weak" sustainability position, if the measures for improved sustainability is implemented. The "weak" sustainability position mentions resource

conservation, manages its growth, and achieves what is considered the common interpretation of sustainable development. We see it as unlikely for cruise tourism to ever achieve a “very strong” sustainability position, based on the analysis conducted.

5.2 Further Research

As concluded above, cruise industry cannot be claimed to be sustainable in an environmental view, based on the findings of this literature review. However, it is prominent to advance the fact that this literature study covers only a small part of sustainability. First, our focus is directed to a third of the three pillars of sustainability: the environmental impacts. Looking away from economical and sociocultural impacts from the industry. Secondly, the part of the environmental impacts is limited to our four chosen sub-topics: air pollution, biofuels, onshore power supply and waste management and wastewater. This is merely a choice based on the availability within the research. Future research should focus in two different directions: the one researching possibilities of transitioning this industry into sustainable ways and technologies. The other should research impacts made by cruise ships om the surrounding environment such as the ocean, and how their operations impact marine life in their area of traffic. Through the process of researching cruise tourism, we have additionally uncovered the need for holistic, objective studies that address several aspects of cruise tourism’s sustainability characteristics. These kinds of comprehensive studies may help to see the full picture of cruise ship’s impacts.

The conclusion of this bachelor’s thesis is clear: cruise tourism cannot become truly sustainable, based on the research on today’s operations, and available technology at the moment of writing and in the imminent future.

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