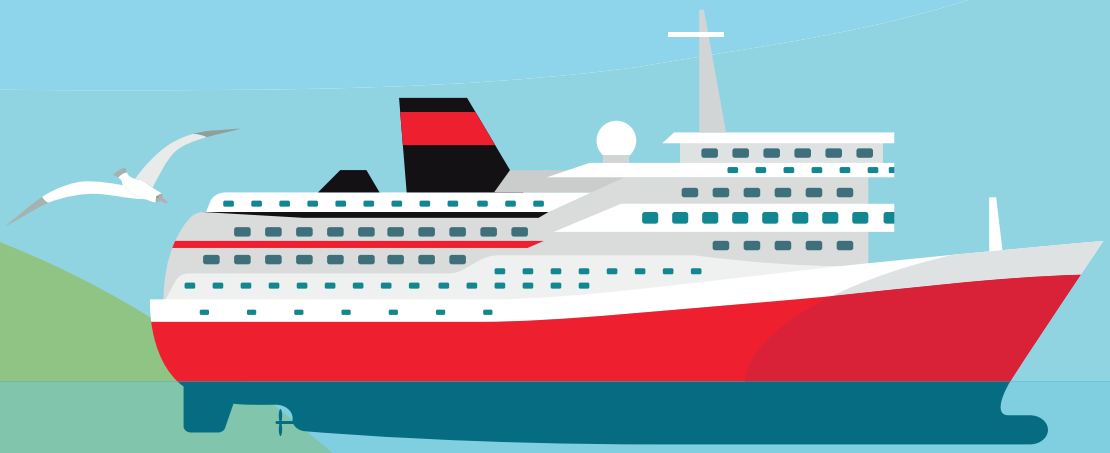
European Commission

Good Practices for Sustainable Cruise Tourism



Final Report

Deloitte Consulting B.V. and Partners
Project finalised in December 2022

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LIST OF ABBREVIATIONS

Abbreviation	Full name
AB	Auxiliary Boiler
AE	Auxiliary Engine
AFID	Alternative Fuels Infrastructure Directive
AWTS	Advanced Wastewater Treatment System
BC	Black Carbon
BWTS	Bilge Water Treatment System
BWMC	Ballast Water Management Convention
CAGR	Compound Annual Growth Rate
Capex	Capital expenditure
CO	Carbon monoxide
CO2	Carbon Dioxide
CO2e	The number of CO2 emissions with the same global warming potential as another greenhouse gas
CLIA	Cruise Line International Association
CSI	Clean Shipping Index
CSR	Corporate Social Responsibility
DCS	Data Collection System
DMMO	Destination Management and Marketing Organisation
DMO	Destination Management Organisation
EAFO	European Alternative Fuels Observatory
ECA	Emission Control Area
EDEN	European Destination of Excellence
EEDI	Energy Efficiency Design Index
EGCS	Exhaust Gas Cleaning System
EGD	European Green Deal
EMAS	Eco-Management and Audit Scheme
EMSA	European Maritime Safety Agency
EMTER	European Maritime Transport Environmental Reports
EPA	Environment Protection Agency
EPI	Environmental Port Index
ESI	Environmental Ship Index
ESPO	European Sea Ports Organisation
ETOA	European Tourism Association
ETS	Emissions Trading System
GHG	Greenhouse Gas
GRI	Global Reporting Initiative
GSTC	Global Sustainable Tourism Council
GSTC-D	GSTC Destination Criteria
GT	Gigatonnes
HELCOM	Baltic Marine Environment Protection Commission
HFO	Heavy Fuel Oil

Abbreviation	Full name
HVAC	Heating, Ventilation and Cooling
HVO	Hydrotreated Vegetable Oil
IAS	Invasive Alien Species
ICCT	International Council on Clean Transportation
IFRC	International Federation of Red Cross and Red Crescent Societies
ILO	International Labour Organisation
IMO	International Maritime Organization
ISHY	Implementation of Hybrid Shipping
ISO	International Organization for Standardisation
KPI	Key Performance Indicator
LED	Light Emitting Diode
LNG	Liquefied Natural Gas
LS MGO	Low Sulphur MGO (Marine Gas Oil-
MARPOL	International Convention for the Prevention of Pollution from Ships
ME	Main Engine
MED	Mediterranean
MGO	Marine Gas Oil
MLC	Maritime Labour Convention
MRV	Monitoring, Reporting and Verification
MS	Member State
Mtoe	Mega tonnes oil equivalent
NOx	Nitrogen oxide
O3	Ozone
Opex	Operational expenditure
OPS	Onshore Power Supply
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PCBs	Polychlorinated biphenyls
PEMFC	Proton Exchange Membrane Fuel Cells
PERS	Port Environmental Review System
PM	Particulate Matter
PM-SO2	Particulate Matter – Sulphur Dioxide
POPs	Persistent Organic Pollutants
PRF	Port Reception Facilities
PRG	Peer Review Group
PV	Photovoltaic
PVC	Polyvinyl Chloride
SECA	SOx Emissions Control Area
SEEMP	Ship Energy Efficiency Management Plan
SOLAS	Safety of Life at Sea
SOx	Sulphur oxide
TBT	Tributyltin
UNWTO	United Nations World Tourism Organization
UV	Ultraviolet
VOS	Volatile Organic Compound
WITC	World Travel and Tourism Council

Abbreviation	Full name
WTO	World Tourism Organization
WTS	Advanced Wastewater Treatment System
WTTC	World Travel and Tourism Council

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ABSTRACT

This study gathered and analysed available evidence on cruise tourism to support cruise stakeholders in moving forward on sustainability. It took place against a policy background of the European Green Deal, the European Commission new approach to sustainable blue economy and the development of a Transition Pathway for tourism. It looked at the economic, social and environmental 'as-is', examined the most promising responses to the challenges, measured economic impact, and documented regulatory and non-regulatory environmental and social frameworks.

There are no one-size-fits-all solutions. There is uncertainty about cost and regulation. Local specificities are important as 13 destination case studies illustrated. However, adopting clear environmental goals, circular economy principles, energy efficiency and fuel flexibility, and collaboration across the ecosystem are no-regrets measures that can be taken now. As a selection of good practices demonstrates, there are practices across a range of cruise players that the industry can look to for learnings, ranging from Onshore Power Supply (OPS), LNG bunkering, sustainable cruise terminals, food waste reduction and waste treatment to a holistic approach to destination management.

RÉSUMÉ ANALYTIQUE

Cette étude rassemble et analyse les données disponibles sur le tourisme de croisière afin d'aider les acteurs de ce secteur à progresser en matière de durabilité. Elle s'inscrit dans le contexte politique du Pacte Vert européen, de la nouvelle approche de la Commission européenne en matière d'économie bleue durable et du développement d'une voie de transition pour le tourisme. L'étude examine la situation économique, sociale et environnementale actuelle, étudie les réponses les plus prometteuses aux défis, mesure l'impact économique et documente les cadres environnementaux et sociaux réglementaires et non réglementaires.

Il n'y a pas de solution unique. Il existe des incertitudes relatives aux coûts et à la réglementation. Les spécificités locales sont importantes, comme l'illustrent 13 études de cas. Cependant, l'adoption d'objectifs environnementaux clairs, les principes de l'économie circulaire, l'efficacité énergétique et la flexibilité des carburants, ainsi que la collaboration au sein de l'écosystème sont des mesures qui peuvent être prises dès maintenant. Comme le montre une sélection de bonnes pratiques, il existe des pratiques parmi un éventail d'acteurs de la croisière dont le secteur peut s'inspirer, qu'il s'agisse de l'alimentation électrique à terre (OPS), du soutage au GNL, des terminaux de croisière durables, de la réduction des déchets alimentaires, du traitement des déchets, une approche holistique de la gestion des destinations.

ZUSAMMENFASSUNG

In dieser Studie wurden die verfügbaren Daten zum Kreuzfahrttourismus gesammelt und analysiert, um die Akteure im Kreuzfahrttourismus bei der Weiterentwicklung der Nachhaltigkeit zu unterstützen. Sie fand vor dem politischen Hintergrund des europäischen Green Deal, des neuen Ansatzes der Europäischen Kommission für eine nachhaltige Seewirtschaft und der Entwicklung eines Übergangspfades für den Tourismus statt. Es wurde der wirtschaftliche, soziale und ökologische Ist-Zustand betrachtet, die vielversprechendsten Antworten auf die Herausforderungen untersucht, die wirtschaftlichen Auswirkungen gemessen und die regulatorischen und nicht-regulatorischen ökologischen und sozialen Rahmenbedingungen dokumentiert.

Es gibt keine allgemeingültigen Lösungen oder Einheitslösungen. Es besteht Ungewissheit über Kosten und Vorschriften. Lokale Besonderheiten sind wichtig, wie 13 Fallstudien zu Kreuzfahrtreisezielen zeigen. Klare Umweltziele, Grundsätze der Kreislaufwirtschaft, Energieeffizienz und Kraftstoffflexibilität sowie die Zusammenarbeit im gesamten Ökosystem sind jedoch Maßnahmen, die ohne Reue ergriffen werden können. Wie eine Auswahl bewährter Praktiken zeigt, gibt es im Kreuzfahrttourismus einer Reihe von Praktiken, von denen die Branche lernen kann, angefangen bei der Stromversorgung an Land (OPS), dem Bunkern von Flüssiggas (LNG), nachhaltigen Kreuzfahrtterminals, der Reduzierung von Lebensmittelabfällen, der Abfallentsorgung bis hin zu einem ganzheitlichen Ansatz für das Management von Reisezielen.

EXECUTIVE SUMMARY

Cruise ships currently under construction will not be decommissioned until around 2065, 15 years after the date set for achieving net zero carbon emissions. Within five years of their launch, i.e. by 2030, they will have to be meeting much more rigorous climate change mitigation standards than currently. Thus, the cruise tourism industry needs to take future-proof action now to achieve both short-term targets, and to ensure that it is on a long-term sustainable path. That applies not just to cruise lines, but to an entire ecosystem that includes ports, destinations and all their stakeholders, including local tourism operators and local authorities – and indeed policymakers at every level.

Defining that path means combining economic, environmental and economic sustainability. Cruise tourism, in the widest sense of the word, needs to be resilient on all three of these dimensions if EU decarbonisation ambitions are to be met and the growth of a niche, but major, contributor to the growth of the EU's blue economy and its tourist industry is not to be stunted.

The challenge for the ecosystem is to keep abreast of evolving regulatory requirements and non-regulatory options, and advances in technology. Clarity on regulation can take time to emerge; there is often no certainty as to which technology is best. Many technologies have promise, but there is uncertainty about what the cost-benefit will be when they reach maturity. In addition, cruise lines and ports must act in concert, with the cruise lines needing to be sure that the ports, and other stakeholders, will make the necessary investments, and vice-versa.

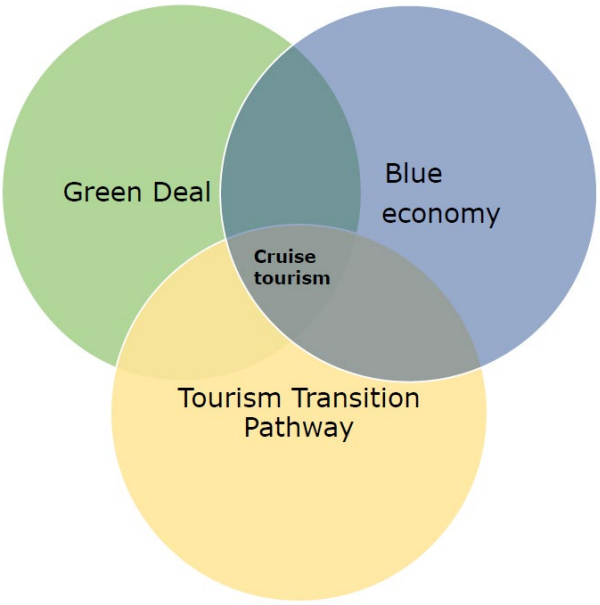
Moreover, while a lack of data on the cruise industry specifically means that the challenges and possible responses must often be defined by extrapolation from general shipping, that has pitfalls. What is right for shipping in general may not be the right priority for cruise lines because they carry large numbers of passengers and crew. For example, cruise ships often berth close to densely populated inhabited areas more vulnerable to air pollution than the areas around cargo ports. The ports used by cruise lines are often smaller than those used by general shipping, posing particular sets of problems. The challenges are such that the different players cannot take decisions in isolation. The whole ecosystem needs to come together to ensure the transition is sustainable.

This study has gathered and analysed available evidence on cruise tourism to support stakeholders in moving forward on sustainability. It took place against a policy background of the European Green Deal, the European Commission new approach to the sustainable blue economy and the development of a Transition Pathway for tourism. It looked at the economic, social and environmental 'as-is', investigated the most promising responses to the challenges, assessed economic impact, documented the regulatory and non-regulatory frameworks. These were the backdrop to proposing a sustainability roadmap with low-regret measures to set the industry on the right path and a framework for identifying good practices across a range of players that different segments of the industry can look to for learnings.

The policy framework

While the regulation continues to evolve, there is also already an extensive EU framework within which cruise tourism needs to take action. This is three-pronged: the EU Green Deal designed to produce a green economy, the approach to the sustainable blue economy and the EU's Transition Pathway for Tourism (Figure 1).

Figure 1 The EU's three-pronged policy approach



Source: Deloitte/Ramboll analysis

The European Green Deal is Europe's overarching sustainability framework for achieving net zero carbon emissions by 2050, no net emissions of greenhouse gases by 2050, economic growth decoupled from resource use, while leaving no person and no place behind.

Within that, the Fit-for-55 package of measures is designed to ensure the EU has cut its emissions by 55% by 2030. This includes key measures affecting cruise shipping, such as the FuelEU Maritime initiative, the revision to the Alternative Fuels Infrastructure Directive and the extension of the Emissions Trading System (ETS) to transport, including shipping.

The overarching framework for cruise tourism within the blue economy is the new approach to transforming the EU's blue economy for a sustainable future[1]. A sustainable blue economy promotes economic growth, social inclusion and improved livelihoods while ensuring the environmental sustainability of oceans and seas.

This means balancing exogenous trends affecting coastal and island tourism in Europe, such as growing global tourism (which can lead to over-tourism), the emergence of new market segments, changes in demand patterns, an ageing society, increased awareness of and a quest for sustainability and quality, and geopolitical instability.

A third element is the EU's Transition Pathway for Tourism[2]. This calls on the tourism industry inter alia to invest in circularity to reduce energy, waste, water and pollution, and at the same time to better meet the increasing demand for sustainable tourism; to share data more to enable the introduction of innovative tourism services and improve the sustainable management of destinations, and to invest in skills to ensure the availability of a qualified workforce and attractive careers in the ecosystem.

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2021:240:FIN
[2] https://data.consilium.europa.eu/doc/document/ST-15441-2022-INIT/en/pdf

The economic dimension

The cruise tourism industry is important for Europe. It contributes to economic activity and generates jobs. The cruise industry may represent only a small fraction (approximately 2%) of total global tourism, but Europe is the second biggest cruise market after North America both in terms of source of passengers and as a cruise destination. In 2019, 25% of global cruise passengers cruised in European waters, predominantly in the Mediterranean and northern part of Europe. It is a EUR 2 billion industry based solely on the economic impact of the cruise lines, their passengers and crew. This accounts for their direct spending and the indirect and induced impacts, but it does not take into account the impact on Europe's shipbuilding industry. Most of the world's large cruise liners are built in European shipyards.

Until the COVID-19 pandemic, cruising had been one of the fastest-growing areas of global tourism in recent decades with an average growth of 7% per year in the last thirty years. COVID-19 was a major blow to the industry, bringing its activities to a halt. However, the industry is economically resilient and is expected to bounce back to 2019 levels of business in 2023, or possibly 2024, depending on the wider impacts of the war in Ukraine or other unforeseen external shocks. The industry is structurally attractive and therefore likely to remain economically resilient, the more so since the demographics of cruisers are favourable to continued strong growth of the industry worldwide and in Europe. Consequently, it can be expected to continue to grow strongly, bringing with it, however, downsides in terms of pressure on destinations from both pollution and tourism numbers. The projected growth of the industry implies that its sustainability ambitions need to evolve and be more widely spread across the industry if the industry is to reach its climate targets. Pivotal to this is close collaboration between all cruise tourism industry stakeholders.

The environmental dimension

Environmental assessments were conducted for this study during 2020 and 2021 to assess the current state of play, both in terms of challenges and responses. The challenges are many. Into the air, they come primarily from propulsion and the CO2, NOx, SOx and particulate matter emissions from burning fossil fuels. Into the water, they come primarily from black water, grey water, waste water and ballast water, and the harm they can do to aquatic life, include introducing invasive alien species (IAS). These IAS can crowd out native species if the environment is right. Disposing of large amounts of waste from ever larger cruise ships carrying ever more passengers is a particular challenge.

There are also many solutions, each having some drawback, e.g. cost, technological immaturity, unsuitability for cruise ships, which need deck space for the cruise experience. There is no winner-takes-all. The use of LNG with scrubbers to take out the toxic emissions is a direction in which the industry is moving but is still based on fossil fuels, and is probably not sustainable in the medium-to-long term. Connecting to an onshore power supply (OPS) cuts emissions in port, but is only truly energy-efficient if the power source is renewable. It is also an archetypical example of cruise lines and ports needing to invest in parallel. However, OPS takes up space that smaller cruise ports often do not have. Just as there is no winner-takes-all, there is no one-size-fits-all. Longer-term, there are options such as hydrogen and biofuels, including biomethanol, or switching to batteries, or drawing some auxiliary power from renewables, but the technologies are not yet mature enough for use on cruise ships, the future cost-benefit is uncertain and it is not clear what choices regulators will make.

Similarly solutions exist to dealing with waste, both by producing less and by treating it better at sea and on land, but they are costly and far from universally deployed at present. They too work best when ports and their ecosystem are using the most advanced technologies and works hand-in-hand with the cruise lines.

Energy efficiency, OPS, and voyage and data optimisation measures are low-hanging fruit, but the industry cannot decarbonise based on these alone. As a starting point the industry needs, where it has not done so already, to adopt clear environmental goals and adopt circular economy principles. It will need to plan a phase-out of sulphur from fuels and develop low-emission fuels, develop fuel flexibility capabilities and roll out zero transmission technologies. It needs to promote good practice and innovation in waste management and accelerate the installation of supporting infrastructure and supply chains.

The social dimension

There are four facets to the social dimension of cruise tourism: minimum requirements for seafarers to work on a ship; conditions of employment; living conditions; health protection, medical care, welfare and social security protection. There is extensive regulation to ensure minimum standards are met. The research for this study suggests that the cruise industry meets these and that the main problems lie in abuses in source countries in recruiting more junior crew members. However, cruise lines have good practice in place to ensure that their recruiting does not involve abuses. Where there is some room for improvement is in provision for welfare and planned career paths that goes beyond the minimum requirements.

Taking a holistic approach

Achieving sustainability requires collaboration across the industry and with policymakers at every level from the EU down to local level. The need for cruise industry players to work together underscores moreover the importance of destination management, of Destination Marketing Organisations (DMOs) becoming Destination Management Marketing Organisations (DMMOs). The overall economic impact of cruise tourism masks very different impacts at destination level depending on different tourism models and the economic characteristics of the destinations, i.e. the extent to which they are dependent on cruise tourism as opposed to tourism in general or on general shipping.

This was illustrated in case studies of 13 cruise tourism destinations, all in the EU except Miami. These case studies considered how well these destinations are rising to the challenge of destination management, environmental sustainability and reaping the socio-economic benefits of cruise tourism. Stockholm emerged as a front-runner with the only real vulnerability being insufficient consultation of the local community. Other destinations all had key weaknesses, and in most cases more weaknesses than strengths.

Failure to consult widely enough was common. So was an absence of monitoring and reporting. In general, there is a lack of joined-up destination management planning, with many destinations struggling to cope with large numbers of cruise passengers during the peak seasons for all tourism. It is also clear, however, that common issues do not mean common solutions. The specificities of each destination need to be taken into account depending on whether they are small or large, whether they are highly dependent on cruise tourism or not, either in terms of tourism numbers or port size, and what model they are pursuing, albeit there is a clear trend towards quality over quantity.

The regulatory dimension: going beyond the minimum

While there is already a large body of environmental and social regulation at international and EU levels, which is documented in this study, there are also many non-regulatory guidelines, standards, labels and incentive schemes to encourage shipping in general, and the cruise industry specifically, to go beyond the regulatory minimum. Some cut across environmental impact categories while others are specific. Non-regulatory measures can assist cruise tourism industry actors in furthering the sustainability of the industry and moving beyond regulatory compliance. Good practices that go beyond the minimum.

Seven good practices were selected out of a long list of some 120 practices to showcase what the cruise tourism industry is already doing towards becoming a more sustainable industry and to inspire others. The good practices are all cruise-tourism specific and have a measurable impact. At least two or more stakeholders from the cruise tourism industry are involved, to highlight the importance of collaboration. The good practices are Europe-based and are making a contribution to one or more objectives of the Green Deal.

The practices are:

- Cruise-specific Onshore Power Supply (OPS) at the cruise terminal of Altona;
- Environmental Ships Index (ESI) at-berth module that calculates cruise ship emissions at the berth that it is planned to implement in various EU ports;
- Sustainable cruise terminal in the Port of Tallinn, Estonia;
- Holistic approach to tourism in Dubrovnik, Croatia;
- Waste reduction programme 4GOODFOOD implemented in at least 8 EU destinations;
- LNG bunkering at the Port of Barcelona, Spain;
- Waste treatment facility at the Port of Stockholm, Sweden.

Conclusions

This study therefore demonstrated good examples and initiatives by the industry in moving towards a more sustainable cruise tourism industry. The sense of urgency is felt; 2030 (and thus the EU Green Deal mid-term goals formulated in the Fit-for-55 package) is only eight years away; net zero is less than three decades away. For an industry, which relies on capital-intensive assets with a long payback period, these goals are approaching rapidly.

Continued growth of cruise tourism seems assured, even if there is uncertainty about whether the industry will return to pre-COVID levels of activity in 2023 and 2024, as there are ongoing external shocks as a result of the war in Ukraine. However, the industry proved its resilience and financial strength during COVID-19 and it has many of the requisite strengths to ensure not only survival but ongoing growth. That includes strong demand for its services.

That growth will falter if the ecosystem, including cruise lines, cannot meet the destination management, environmental and social challenges it is currently confronting. With a 40-year planning horizon for cruise ships, all stakeholders need to ensure the decisions they take now will be future-proof.

The environmental challenges in particular are daunting. The industry is committed to a net-zero future, but the transition pathway is not necessarily obvious, and the regulatory and non-regulatory frameworks are constantly evolving as the technology evolves.

Many solutions exist. Many have merit, but there are no clear front runners. Many of the green technological solutions investigated are inhibited by low technological and/or commercial maturity.

Destinations are also very different. What might be right for a large port or a destination highly reliant on cruise tourism may well not be right for a small port or destination where tourism is secondary to other activities.

Developments in green technological solutions all have a different timespan. Some options (such as those improving energy efficiency) could be implemented in the short term to capture immediate gains and help abate the costs of larger technological investments. Fuel flexibility is recommended as the best hedging option against technological and investment uncertainty, which have a longer development time.

A clear regulatory landscape to enhance the predictability of an uncertain technological and energy landscape is a prerequisite for enabling some green technologies.

However, the cruise ecosystem is complex. The cruise lines do not and cannot operate in a vacuum. They are both part of a complex ecosystem which includes policymakers at international, EU, national and local level. Sustainability will require coordination, dialogue and support across all stakeholders (especially between destination management organisations, local governments, ports, tourism operators, civil groups and cruise lines).

This study should be seen as an effort to promote and continue the dialogue between cruise tourism industry stakeholders. Some good practices which show that the industry has made progress over the past years can kickstart this phase of the dialogue. It must be based on 'collaboration': no actor can achieve the goals alone.

Balancing the interests of all stakeholders is crucial. Striking the appropriate balance to protect and enhance resources while still meeting the needs of all stakeholders (at present and in the future) is a complex task. Over the past years, the European Commission has contributed to the process of a more sustainable cruise tourism industry by assessing the impact of initiatives, stimulating initiatives via grants and incentive schemes, and through regulation. This study is an example of the European Commission playing a facilitating role, bringing together industry stakeholders and showcasing good practices across the geographies and players involved in the industry in Europe to promote a more sustainable cruise tourism industry.

INTRODUCTION

Climate change and environmental degradation are an existential threat to Europe and the world. In the new policy agenda it set in 2019, the European Commission made tackling these challenges through the European Green Deal (Figure 2), a top priority for the economy as a whole. European Commission President, Ursula von der Leyen, has described it as "Europe's Man on the Moon moment".[3]

The European Green Deal will transform the EU into a modern, resource-efficient and competitive economy, ensuring:

- no net emissions of greenhouse gases by 2050, i.e. a climate-neutral economy by 2050
- a reduction in net greenhouse gas emissions by at least 55% by 2030
- economic growth decoupled from resource use
- no person and no place is left behind.

Figure 2 The European Green Deal

Source: European Commission

[3] https://ec.europa.eu/commission/presscorner/detail/en/speech_19_6749

The European Green Deal is also **the EU's lifeline out of the economic impacts of the COVID-19 pandemic**. Part of that lifeline is working to get the tourism sector back on its feet. Financial assistance is part of that, but the development of the EU Digital COVID Certificate and other health and safety labels have made an important contribution to the tourism industry's recovery. They have been particularly important for the cruise tourism industry, whose image took a hit from early outbreaks onboard cruise vessels.

Building back better

The pandemic highlighted the vulnerabilities of the tourism sector to economic shocks. Against the background of the Green Deal, the European Commission's goal now is to **build back better, to make tourism not only more resilient, but also more sustainable**. Tourism in Europe is already undergoing change. Recent Eurobarometer surveys indicate that 82% of Europeans are prepared to change their travel habits to make their journey more environmentally, socially and economically sustainable.[4]

The recovery now haltingly under way is an opportunity to **develop an EU framework for environmentally, socially and economically sustainable tourism**. Even though several EU Member States and regions have sustainable tourism strategies in place, there is growing consensus that the EU needs a dedicated framework for sustainable tourism, i.e. a "transition pathway for tourism".

In March 2021, the European Parliament invited the European Commission in a resolution to establish a new EU strategy for sustainable and strategic tourism aligned with the Digital Agenda, the European Green Deal and the UN Sustainable Development Goals. In May 2021, the European Council called on the European Commission to propose an outline for an 'EU Agenda for Tourism 2030'. This was endorsed by the Council of the European Union (i.e. the Member States) in December 2022[5].

There is a **strong consensus among EU Member States that a European framework for sustainable tourism** is desirable, facilitated and coordinated by the European Commission. In endorsing the EU Agenda for Tourism 2030, Member States highlighted the importance of the process of co-creation with Member States and stakeholders led by the Commission under the Transition Pathway for Tourism[6] and the contribution it will make to the transition of tourism towards a more resilient ecosystem.[7]

Sustainable cruise tourism is part of that. It is an integral part of the EU's tourism transition strategy and at the same time **firmly embedded in the EU's overall blue economy strategy** launched in May 2021, which is also predicated on building back better. As Virginijus Sinkevičius, Commissioner for the Environment, Fisheries and Maritime Affairs said at the launch: "The pandemic has hit the marine economy sectors in different, but profound ways. We have an opportunity to start afresh, and we want to make sure that the recovery shifts the focus from mere exploitation to sustainability and resilience. Thus to be truly green, we must also think blue."[8]

This strategy covers all blue economy sectors including fisheries, aquaculture, coastal tourism, maritime transport, port activities and shipbuilding. This requires every blue economy sector to adopt more sustainable business models in order to reduce the

[4] https://europa.eu/eurobarometer/surveys/detail/2283
[5] https://www.consilium.europa.eu/en/press/press-releases/2022/12/01/new-european-agenda-for-tourism/
[6] European Commission – Transition pathways for tourism; https://op.europa.eu/en/publication-detail/-/publication/404a8144-8892-11ec-8c40-01aa75ed71a1
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cumulative impact of economic activities. As the largest blue economy sector, coastal and maritime tourism – including cruises – are a focal point.

The blue economy strategy is being deployed in conjunction with the European Commission's **Fit-for-55 package under the Green Deal**, i.e. the package of measures designed to ensure that the target of a 55% reduction in greenhouse gas emissions by 2030 is met. This has major implications for the cruise tourism ecosystem, notably through the extension of the EU Emissions Trading System to the maritime sector, the requirements on Alternative Fuels Infrastructure, which affects both shipping in all forms, and ports and their stakeholders, and the FuelEU Maritime initiatives, which it is envisaged will lead to legislation on the uptake of cleaner maritime fuels. The package covers a wider range of other measures which will additionally affect the maritime sector to some extent (text highlighted in blue in Figure 3.)

Figure 3 The Fit-for-55 package

Source: European Commission

The role of the EU and the European Commission

The EU as such does not possess exclusive competencies to regulate cruise tourism throughout Europe. The EU provides technical and financial assistance to develop sustainable cruise tourism, and it sets (often challenging) environmental and social regulatory baselines, areas where it does have competence. It also plays a key role in bringing the stakeholders from across the ecosystem together to develop sustainable business models and deploy innovative new technologies and concepts with growth potential, thus facilitating change.

In the specific case of cruise tourism, this is only possible by engaging all cruise tourism stakeholders through cooperation: the cruise industry, European sea ports, tourism authorities and organisations, destination management organisations, and, last but not least, European agencies, e.g. the European Maritime Safety Agency (EMSA) and the

European Environment Agency (EEA). This requires a shared vision, a shared commitment and a shared mindset, but these must at the same time recognise that there is no one-size-fits all for sustainable growth of cruise tourism destinations. They each have their specificities.

Two Pan-European Cruise Dialogues have played a key role in launching the necessary collaboration. Participants in that Dialogue committed to cooperation for the promotion of competitive and sustainable cruise, coastal and maritime tourism in Europe with shared benefits for all stakeholders, including include the coastal and insular communities. They will also work with the main coastal tourism stakeholders to overcome the challenges that they face, namely seasonality, sustainability and accessibility. They need to do that by cooperation on innovation and digitalisation for the cruise, coastal and maritime tourism sector, including by encouraging skills training development; promoting existing stakeholder networks and initiatives for cooperation, dialogue and best practice exchange in the sector; continuing the dialogue on a European level to address common challenges; collaborating on towards the development of quality services for the cruise tourism offer to increase the position of Europe as a cruise destination.

The transition pathway will not always be easy. It will be challenging for all stakeholders to make no-regrets decisions now when the 40-year average life of a cruise ship means those being built now will still be sailing ten years after the EU achieves net zero.

This study, the findings of which were validated by an external Peer Review Group (PRG), provides an assessment of where the cruise tourism ecosystem is now, the sustainability challenges it faces, but above all highlights possible solutions and in particular good practices to support the ecosystem's discussions on their own transition pathway, and leverage and amplify their joint efforts. It also throws a spotlight on the extent to which there are gaps in data-gathering by international organisations and statistical bodies, which have to be filled through extrapolation from data on shipping as a whole or by relying on industry data which is not necessarily homogenous.

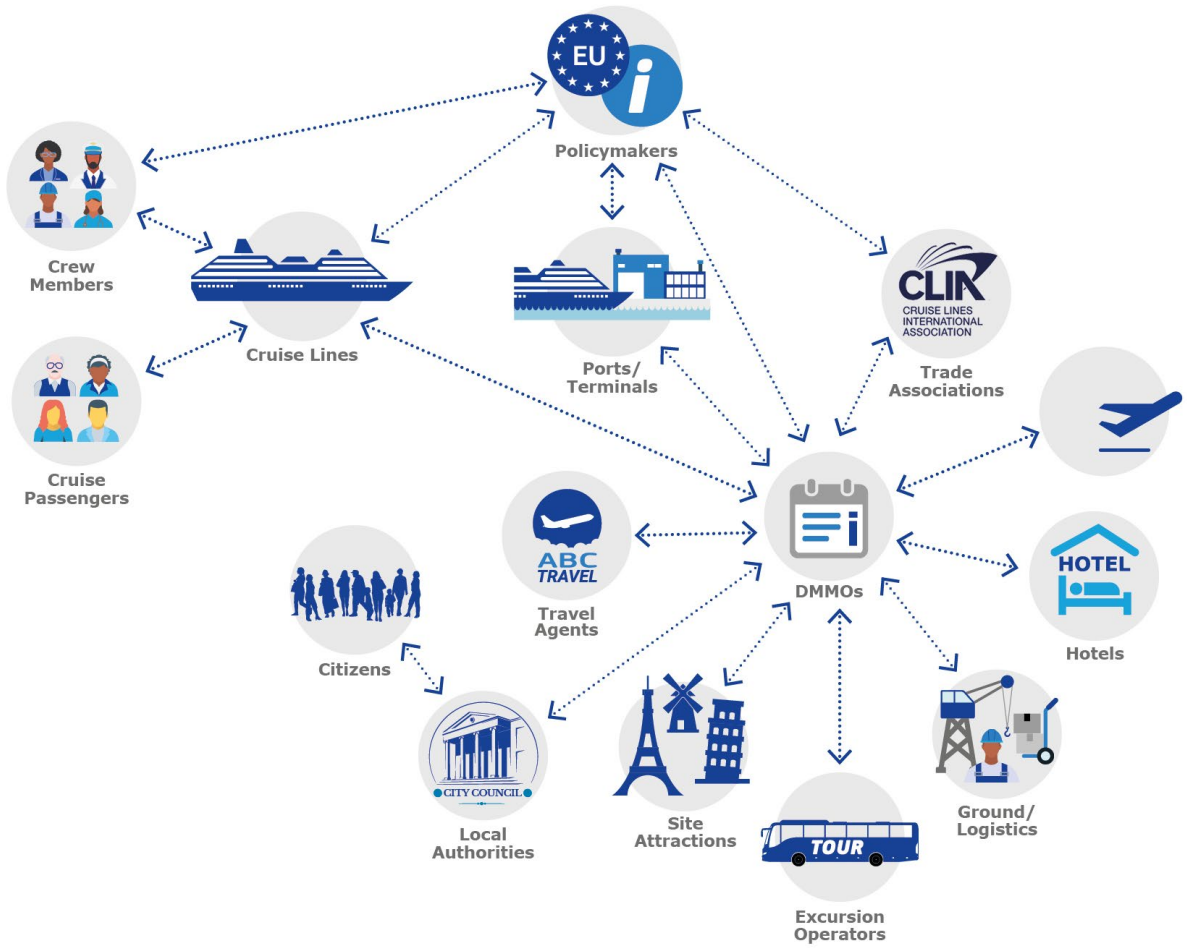
CHAPTER 1: CRUISE TOURISM – A COMPLEX ECOSYSTEM

1.1 Introduction

Traditionally, the cruise tourism industry has been perceived as a fairly simple ecosystem, which includes destination management and marketing organisations (DMMOs), port authorities and tourism operators who work with cruise line companies that then provide services to cruise tourists.

As important background to this study, it is important to understand that this is too narrow a view and **a very wide group of stakeholders needs to be engaged if cruise tourism is to develop sustainably**. Each has specific roles and faces specific issues (Table 2), which need to be understood as context when reading this study, albeit the study has a particular focus on measuring the impact of and implications for cruise lines, ports and destinations as the major players.

Figure 4 The cruise industry ecosystem



Source: Deloitte/Ramboll analysis

Table 2 Roles of cruise tourism stakeholders and key issues

Entity	Role	Key issues
Cruise lines	Providers of the cruise experience and developers of new itineraries/destinations to meet customer expectations, and intrinsic to the cruise ecosystem	Environmental challenges (e.g. waste management, pollution, etc.) Should bring economic benefits to destinations
Ports/terminals	Responsible for providing adequate piers and cruise terminal facilities for cruise vessels to dock safely to embark and disembark their passengers (either on turnaround or transit calls)	Environmental challenges (e.g. dredging, shore energy) Need to provide adequate space and facilities for immigration, customs and health and ample space for tour buses and logistics
DMMOs	Responsible for managing the destination by means of implementing strategies via action plans and promoting the destination's brand image and experience for cruise passengers	Need to promote responsible travelling behaviour and awareness of natural and cultural heritage
Policymakers (EU institutions, Member States)	Set regulation that governs every aspect of cruise tourism, notably on environment and social sustainability of cruise lines, ports and directly or indirectly the remainder of the ecosystem	Keeping abreast of technology changes and identifying the best no-/low-regret choices for Fit-for-55 package, Green Deal, blue economy approach and tourism transition pathway
Destination players - Local policymakers (municipalities), National Tourism Organisations, etc.	Develop responsible strategies for tourism and city planning within the destination	Need to consider multiple stakeholders and develop adequate policy to maintain destination Maximise economic and social benefits whilst minimising environmental impacts
Cruise passengers	Represent the demand and desire for cruise tourism and experience	Need to be aware of green and responsible travelling behaviour Need to respect local laws and regulations as well as host destination cultural sites Should create positive economic impact on the host destination
Crew members	Work on cruise-related operations and ensure passenger safety throughout	Need to respect local laws and regulations as well as host destination cultural sites Could create positive economic impact at the host destination and locations which facilitate crew changes

Entity	Role	Key issues
(Trade) associations	Represent cruise ships, cruise terminals, tour operators and agencies, etc.	Should promote responsible cruise tourism development Should help members ensure resources are available to develop sustainable cruise tourism
Site attractions/local businesses	Operate and maintain the cultural sites/facilities and areas visited by cruise passengers	Capacity constraints due to visitor flow Should promote sustainable travelling behaviour Economic leakage in cruise passenger revenue
Travel agents	Sell cruise tourism-related products to cruise passengers	Should promote responsible travel and responsible cruise tourism
Excursion operators	Provide cruise lines with (or independently provide) shore excursion packages for cruise passengers	Capacity constraints due to visitor flow Organise responsible excursions which follow local regulations Economic leakage in cruise passenger revenue
Airports	Responsible for transporting fly-and-cruise passengers to home and ports	Environmental challenges (e.g. air pollution) Demand match with cruise trips Work with logistics parties from airports to cruise terminals
Hotels	Accommodate cruise passengers' overnight stays prior to or after the cruise trip	Need to promote responsible travelling behaviour Sustainable design & resource use
Ground logistics	Transport cruise passengers within the destination or from/to the ports	Capacity constraints due to visitor flow Environmental challenges (e.g. air pollution emissions) Waste management and maintenance
Citizens	Represent the local community and offer feedback to public authorities	Should be involved in giving regular feedback on the development of cruise tourism in the destination

Source: Deloitte/Ramboll analysis

1.2 Contextual overview

The ecosystem is complex, but the cruise lines are the drivers of growth, and of economic and environmental impacts. The cruise tourism industry has grown significantly in recent decades. It catered for 27 761 142 passengers worldwide in 2019[9], with an annual growth rate of 6.6% between 1990 and 2020.[10] Cruise line operators have experienced significant expansion over the past two decades.

Even after the 2008 financial crisis, the global cruise tourism business showed stable growth and persistent recovery. Demand for the cruise experience has increased, as seen from the compound annual growth rate (CAGR) of 7% in the number of cruise passengers taking cruises between 1990 and 2020 (before the COVID-19 pandemic)[11]. At the same time, cruise line companies have consistently promoted various ambitious and capital-intensive strategies to sustain this business growth.

1.3 The impact of the pandemic

However, from when the pandemic began in January 2020, there were only a few travel sectors that were worse hit by the pandemic than the global cruise tourism industry. As soon as the outbreak started, cruise lines took immediate action to ensure the health and well-being of guests and crew members. Nevertheless, cruise lines were affected by the spread of the virus on a number of cruise ships[12]. The unpredictable and fast-paced evolving regulations across ports around the world further complicated the issue, with ships being denied entry at ports while cruise line companies worked to repatriate all their crew members and passengers. **The entire industry came to a halt following a voluntary suspension of operations in March 2020**.

Pandemic-induced regulations prevented cruise ships from sailing and resulted in significant revenue loss (e.g. from paying cancellation fees, reimbursement of tickets, and costs associated with ships docking at various ports)[13]. The financial impacts were significant and led to the closure of a few smaller and less financially robust cruise lines. However, **the major cruise lines were able to survive the pandemic**.

However, this resulted in **a shift in financial priorities, focusing on recovery instead of enhancement**, saving costs by decommissioning older ships and raising capital to maintain the liquidity essential for operations and upkeep costs. As the next chapter will set out in more detail, the industry is expected to recover fully within the next couple of years, though the exact timing will depend on the impact of other external shocks, such as the war in Ukraine, and on where that impact falls in terms of origins and destinations of passengers.

The financial impact of the pandemic may have an impact on the pathway for the cruise tourism industry ecosystem to reach sustainability targets and needs to be taken into account when evaluating the progress towards a carbon-neutral 2050.

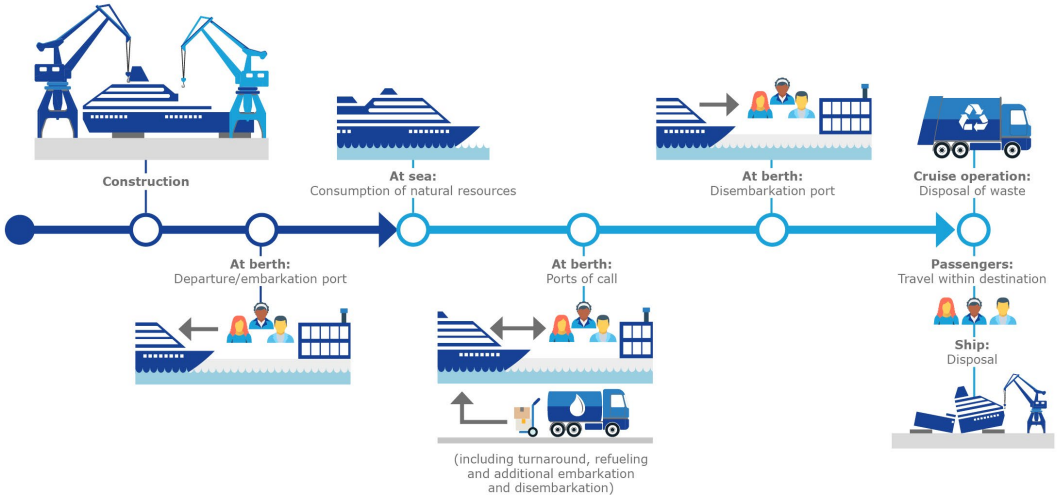
1.4 The challenges going forward

As part of the industry's growth, cruise ships are becoming larger, more numerous and serving more destinations. Inevitably these ships (and their supporting infrastructure, supply chains and partners) consume resources and produce waste. Without mitigating

[9] Cruise Industry News (CIN). 2021. Annual report 2021. https://www.cruiseindustrynews.com/annual-cruise-industry-report.html
[10] Cruise Market Watch. 2021. https://cruisemarketwatch.com/growth/
[11] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7519395/
[12] https://edition.cnn.com/travel/article/11-days-cruising-changed-forever/index.html
[13] https://home.kpmg/xx/en/blogs/home/posts/2020/07/covid-19-impacts-on-global-cruise-industry.html

technologies in place, these pressures can create environmental impacts – such as excessive air emissions, oil spills and waste dumping – that harm the environment and the people that depend upon it.[14] [15] A schematic representation of the life cycle of the industry and its impacts is in Figure 5. This further underscores the complexity of the ecosystem.

Figure 5 Lifecycle of cruise tourism



Source: Deloitte/Ramboll analysis

In recent years the environmental impacts of cruise ship tourism have come under increasing scrutiny – most notably by local authorities and environmental NGOs – as to how it takes responsibility for its environmental impact. As a public-facing segment of the marine industry with growing corporate and public visibility, **cruise tourism stakeholders have been subject to sharp public criticism for their adverse environmental impact** – not always unjustified.[16] [17].

Many of the environmental impacts are not necessarily unique to the cruise tourism industry but applicable across the entire marine sector, and cruise ships represent only a small proportion of the global maritime fleet.[18] Nevertheless, **certain types of environmental challenges, such as air pollution and waste discharges, can be of greater concern for cruise ships relative to other seagoing vessels on a unit (per ship) basis**, owing to the large numbers of passengers and crew that cruise ships carry, and the large volumes of energy consumed and waste produced. Furthermore, their impacts are perceived as particularly damaging given that cruise tourism usually operates

[14] Lloret, J., Carreño, A., Carić, H., San, J. and Fleming, L.E., 2021. Environmental and human health impacts of cruise tourism: A review. Marine Pollution Bulletin, 173, p.112979.
[15] MacDonald, James. 2019. The High Environmental Costs of Cruise Ships. JSTOR Daily. https://daily.jstor.org/the-high-environmental-costs-of-cruise-ships/
[16] Mervosh, S. 2019. Carnival Cruises to Pay $20 Million in Pollution and Cover-Up Case. Nytimes.com. https://www.nytimes.com/2019/06/04/business/carnival-cruise-pollution.html. [Accessed 27 July 2021].
[17] Associated Press. 2021. The $40m 'magic pipe': Princess Cruises given record fine for dumping oil at sea. The Guardian. https://www.theguardian.com/environment/2016/dec/02/the-40m-magic-pipe-princess-cruises-given-record-fine-for-dumping-oil-at-sea [Accessed 27 July 2021].
[18] Oxford Economics. 2020. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/research-updates/research/clia-environmental-study-report.ashx

in highly valued and sensitive coastal water and marine ecosystems, as well as near urban areas and large population centres.

The European policy framework creates a clear imperative and lever to decarbonise the cruise tourism industry. The EU is committed to implementing the Paris Agreement[19]. In that context, the Fit-for-55 legislative package calls for reductions in greenhouse gas emissions (GHG) by at least 55%below 1990 levels by 2030 as set out in the Climate Target Plan and woven into the European Climate Law[20]. It puts the EU on a responsible path to becoming climate neutral by 2050. To achieve climate neutrality, a 90% reduction in transport emissions is needed by 2050, to which all transport modes, including maritime transport, will have to contribute.

With the European Green Deal[21] as an overarching policy framework, achieving significant reductions in GHG emissions in the cruise tourism industry will broadly require using both less energy (increasing energy efficiency) and cleaner types of energy (using renewable and low-carbon fuels, as well as the use of onshore power supply (OPS) at berth). However, **an integrated approach to tackling the industry's environmental impacts is required.** The zero pollution ambition, which stems from the European Green Deal, takes such an approach by considering other pollution forms and sources such as waste, contaminants, and underwater noise.

With this policy obligation in place and commitments by other countries to comply with the Paris Agreement, many cruise tourism stakeholders are already committing to greater environmental sustainability and are increasing transparency. 95% of the world's oceangoing cruise capacity as well as 54 000 travel agents (with 15 000 of the largest travel agencies in the world) are voluntary members of the Cruise Lines International Association (CLIA) – an organisation that places **obligations on CLIA members to reduce the rate of carbon emissions by 40% by 2030 compared to 2008 levels and pursue net-zero carbon neutral cruising globally by 2050.**[22] Implementing sustainable technological solutions – facilitated by stakeholder coordination, clear policy and capital investment in the broader sector ecosystem – will be critical if these commitments are to be met.

1.5 Findings

Cruise tourism is characterised by bringing large numbers of people to concentrated areas of destinations for brief periods of time, thus multiplying and concentrating the potential positive as well as negative impacts of cruise tourism. Those positive impacts include the contribution to economic development, including benefits to local economies; the negative impacts include discharges into the air and water, while at sea and in port, and the potential for over-tourism. **Balancing the interests of all stakeholders**, including cruise lines and shoreside parties, **is crucial in managing the challenges** the industry faces, which are not just, as this chapter has illustrated, a question of the challenges the cruise lines face but of a complex ecosystem.

[19] United Nations. 2015. Adoption of the Paris Agreement. https://unfccc.int/sites/default/files/english_paris_agreement.pdf
[20] European Union. 2021. Regulation (EU) 2021/119 of the European Parliament and of the Council. Official Journal of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R1119
[21] European Commission. (2022). A European Green Deal. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[22] https://cruising.org/en-gb/news-and-research/press-room/2022/october/cruise-industry-demonstrates-commitment--to-pursuing-net-zero-carbon-cruising-globally-by-2050

CHAPTER 2: CRUISE TOURISM - RESILIENCE OF SUPPLY

2.1 Introduction

For an industry to be environmentally sustainable and meet the Green Deal and Fit-for-55 targets and requirements, it must be financially resilient and supported by strong demand for its products and services. This chapter and the next assess the extent to which that is the case of the cruise tourism industry as such, as it is the hub of the ecosystem. **This chapter looks at the supply side of the industry**, i.e. role of the major players and the structural attractiveness of the industry. The next chapter looks at the demand-side, i.e. the travel patterns of consumers and the current and future demographics of the cruise industry's customers.

2.2 The major players

This is **an oligopolistic market** with a small number of firms, each of which has a large slice of the total market of ~ EUR 38.5 billion and none of which therefore can keep the others from having significant influence. Those four players are Carnival Corporation & Plc, Royal Caribbean Group, Norwegian Cruise Line Holdings and MSC Cruises (Table 3). They account for more than 90% of total revenue (Figure 6).[23]

Table 3 The world's four largest cruise line operators

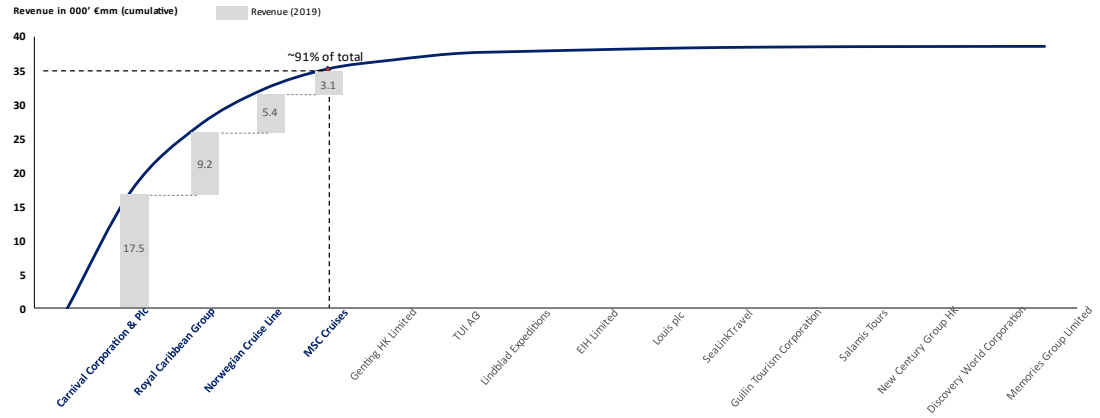
Name	Thumbnail sketch
Carnival Corporation & Plc	Carnival (NYSE: CCL) is headquartered in Miami, Florida. It was set to deploy **52 ships** on the seas by the end of fiscal 2021 as the COVID-19 pandemic waned. Its portfolio of brands includes Carnival Cruise Lines, Holland America, Princess Cruises and Seabourn in North America; P&O Cruises and Cunard Line in the United Kingdom; Aida in Germany; Costa Cruises in Southern Europe, and P&O Cruises Australia. Additionally, Carnival also owns Holland America Princess and AlaskaTours in Alaska and the Canadian Yukon. Carnival's brands attracted about **13 million guests** and had **249 000 lower berths**[24] in 2019, prior to COVID-19.
Royal Caribbean Group	Royal Caribbean Group (NYSE: RCL) has a global fleet of **64 ships** sailing to approximately 1 000 destinations around the world. It is headquartered in Miami, Florida. Royal Caribbean Group is the owner and operator of three cruise brands: Royal Caribbean International, Celebrity Cruises and Silversea Cruises, and it is also 50% owner of a joint venture that operates TUI Cruises and Hapag-Lloyd Cruises. Together, the brands had an additional ten ships on order as of June 30, 2022. RCG's brands attracted about **6.5 million guests** and had **141 570 lower berths** in 2019, prior to COVID-19.

[23] Based on 2019 revenue data extracted from S&P Capital IQ, the top four cruise line companies constituted ~91% (~ EUR 35.2 billion) of the total market (~ EUR 38.5 billion). The data only contains information on companies that report their annual earnings.
[24] Lower berths is the standard metric in the cruise industry and is based on an assumption that each cabin holds two berths, even if in practice accommodation may not be physically berth-based.

Name	Thumbnail sketch
Norwegian Cruise Line Holdings	Norwegian Cruise Line Holdings (NYSE= NCLH) operates **28 ships** across three brands (Norwegian, Oceania and Regent Seven Seas), offering both freestyle and luxury cruising. It is headquartered in Miami, Florida. With nine passenger vessels on order among its brands through 2027 (representing 24 000 incremental berths), Norwegian Cruise Line is growing capacity faster than its peers, expanding its brand globally. NCLH's brands attracted about **2.7 million guests** and had **59 150 lower berths** in 2019, prior to COVID-19.
MSC Cruises	MSC Cruises has a fleet of over **20 ships**. It is a privately-owned cruise line and part of the Mediterranean Shipping Company S.A. (MSC), the world's second-biggest container shipping operator. It is headquartered in Geneva. All MSC Cruises operate under the MSC brand. MSC Cruises is the leader in Europe, South America, the Gulf region and Southern Africa, with a higher market share and the highest deployed capacity compared to any other major players. It also has a strong presence in the Caribbean, North America and Far East markets. MSC Cruises' brands attracted about **2.7 million guests** prior to COVID-19.

Source: Deloitte/Ramboll analysis

Figure 6 Industry revenue in EUR '000 million (2019)



Note: 1) Only publicly listed companies are included, except for MSC Cruises which is a private holding; all reported USD have been converted to Euros at the rate of 1 USD = 0.841 EUR; 2) Only the cruise sector's revenue is included
Source: S&P Capital IQ, Deloitte analysis

Source: Deloitte/Ramboll analysis

2.3 Structural attractiveness

To assess resilience and the competitive environment, this study used the Porter's five forces methodology to assess the industry's structural attractiveness.[25] This methodology looks at the power of a company's competitive rivals, potential new market entrants, suppliers, customers, and substitute products that influence a company's profitability.

The Figures below illustrate the results in relation to the threat of new entrants, threat of substitute products or services, the bargaining power of service providers, the bargaining power of product suppliers, the bargaining power of buyers and rivalry among existing competitors. The use of red, yellow and green illustrates where the risks are high, medium or low. The relevance to the overall picture was measures on the basis of assessments by a Peer Review Group (PRG).

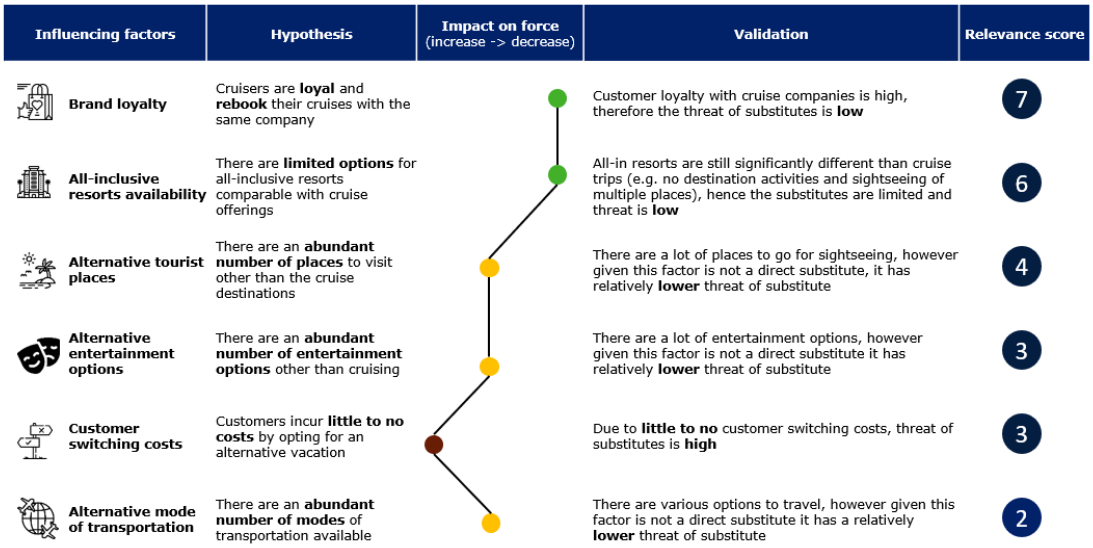
Figure 7 Threat of new entrants

Influencing factors	Hypothesis	Impact on force (increase -> decrease)	Validation	Relevance score[1]
Role of economies of scale	Existing players can **benefit** from economies of scale		Existing players possess the advantage of economies of scale, this creates a barrier for new entrants which **decreases** the threat	8
Capital expenditure requirements	Cruise industry has significantly **higher capital expenditure** than other sectors		High CAPEX/revenue ratio illustrates the significant capital requirements, which is a barrier for new players and **decreases** the threat	8
Incumbency advantages	Incumbents have the **experience and expertise**		Incumbents have developed expertise and cost efficiencies over the years, which **limit the new players** from entering the market	7
Access to distribution channels	All players have **equal access** to ports		Some brands may have priority access at certain locations, however access to ports is **generally the same** for everyone leading to higher threat of entrants	5
Government policies	Policies are **partially restricted** as governments generally welcome cruise ships		This factor may be different post COVID-19, however policies are **the same for all players** leading to higher threat of entrants	5
Customer switching costs	Customers incur **little to no costs** by opting for a different cruise line		Due to **little to no** customer switching costs, threat of new entrants is **high**	2

Note: 1) These are averaged scores based on PRG member input on the relevance of influencing factors to the overall analysis

[25] Harvard Business Review: https://hbr.org/2008/01/the-five-competitive-forces-that-shape-strategy

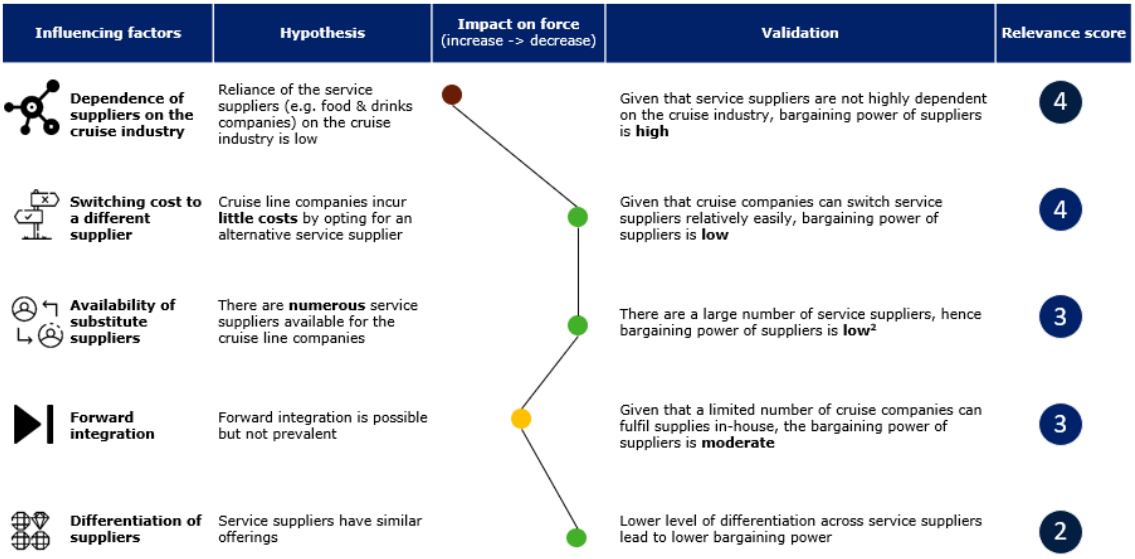
Figure 8 Threat of substitute products or services



Influencing factors	Hypothesis	Impact on force (increase -> decrease)	Validation	Relevance score
Brand loyalty	Cruisers are **loyal** and **rebook** their cruises with the same company		Customer loyalty with cruise companies is high, therefore the threat of substitutes is **low**	7
All-inclusive resorts availability	There are **limited options** for all-inclusive resorts comparable with cruise offerings		All-in resorts are still significantly different than cruise trips (e.g. no destination activities and sightseeing of multiple places), hence the substitutes are limited and threat is **low**	6
Alternative tourist places	There are an **abundant number of places** to visit other than the cruise destinations		There are a lot of places to go for sightseeing, however given this factor is not a direct substitute, it has relatively **lower** threat of substitute	4
Alternative entertainment options	There are an **abundant number of entertainment options** other than cruising		There are a lot of entertainment options, however given this factor is not a direct substitute it has relatively **lower** threat of substitute	3
Customer switching costs	Customers incur **little to no costs** by opting for an alternative vacation		Due to **little to no** customer switching costs, threat of substitutes is **high**	3
Alternative mode of transportation	There are an **abundant number of modes** of transportation available		There are various options to travel, however given this factor is not a direct substitute it has a relatively **lower** threat of substitute	2

Note: 1) These are averaged scores based on PRG member input on the relevance of influencing factors to the overall analysis

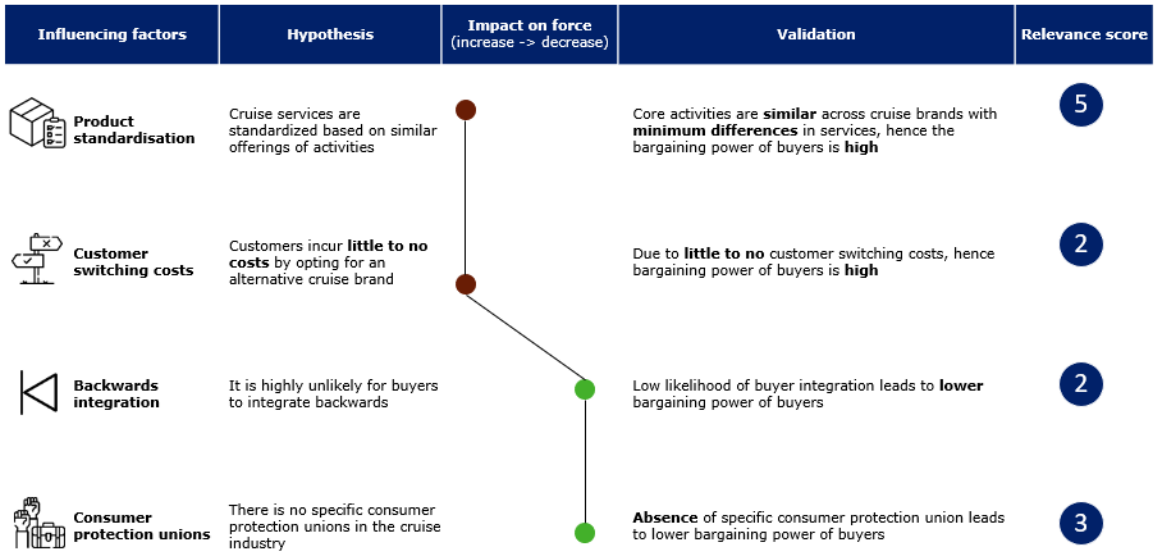
Figure 9 Bargaining power of service providers



Influencing factors	Hypothesis	Impact on force (increase -> decrease)	Validation	Relevance score
Dependence of suppliers on the cruise industry	Reliance of the service suppliers (e.g. food & drinks companies) on the cruise industry is low		Given that service suppliers are not highly dependent on the cruise industry, bargaining power of suppliers is **high**	4
Switching cost to a different supplier	Cruise line companies incur **little costs** by opting for an alternative service supplier		Given that cruise companies can switch service suppliers relatively easily, bargaining power of suppliers is **low**	4
Availability of substitute suppliers	There are **numerous** service suppliers available for the cruise line companies		There are a large number of service suppliers, hence bargaining power of suppliers is **low**[2]	3
Forward integration	Forward integration is possible but not prevalent		Given that a limited number of cruise companies can fulfil supplies in-house, the bargaining power of suppliers is **moderate**	3
Differentiation of suppliers	Service suppliers have similar offerings		Lower level of differentiation across service suppliers lead to lower bargaining power	2

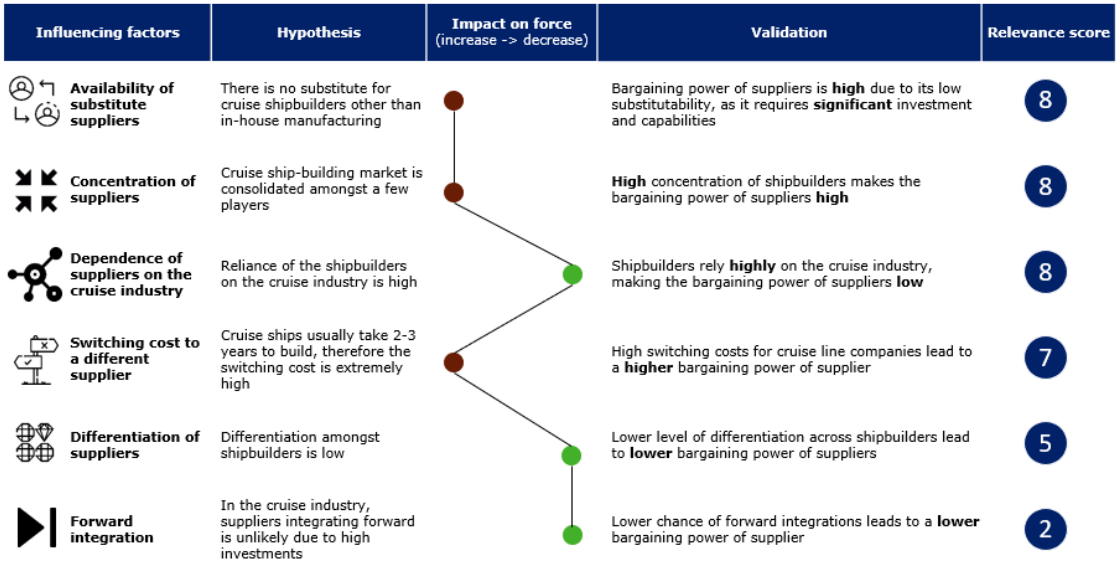
Note: 1) These are averaged scores based on PRG member input on the relevance of influencing factors to the overall analysis; 2) A recent trend observed is the increased reshoring to Europe due to disrupted supply chains during COVID-19

Figure 10 Bargaining power of buyers



Note: 1) These are averaged scores based on PRG member input on the relevance of influencing factors to the overall analysis

Figure 11 Bargaining power of product suppliers



Note: 1) These are averaged scores based on PRG member input on the relevance of influencing factors to the overall analysis

Figure 12 Rivalry among existing competitors

Influencing factors	Hypothesis	Impact on force (increase -> decrease)	Validation	Relevance score
Sustainable advantage through innovation	Major cruise lines are continuously innovating in order to achieve sustainable advantage		The fast pace of innovation makes the intensity of rivalries **stronger**	9
Exit barriers	The industry is capital intensive, hence exit barriers are high		High exit barriers encourage players to maintain an agreeable position in the market, hence **decreasing** the level of rivalries	8
Power concentration	Larger cruise players have majority market shares resulting in an uneven distribution		Top players have majority market shares, which leads to lower level of rivalries	8
Number of competitors	There are limited number of cruise line operators resulting in lower competition		Limited number of players keep the intensity of rivalries at **moderate** level	7
Market share of competitors	Competitors have stable market shares in the last decade		The recent relatively stable years has been keeping the level rivalries at **moderate** level	6
Industry growth	The industry has a stable growth ~8% per year in revenue and ~5% in number of cruisers		Stable industry growth enables players to expand due to natural market growth, resulting in **lower** level of rivalries	6

Note: 1) These are averaged scores based on PRG member input on the relevance of influencing factors to the overall analysis

In summary, the **threat of new entrants is low**. The price for a cruise ship starts at around USD 550 million for a passenger capacity of 500; ships aiming to carry more than 5 000 passengers are rarely built for under USD 1 billion. Operating many ships allows a company to keep costs down on a per-passenger basis. A new player would be operating at a cost disadvantage in purchasing, fuel, etc. Some new and niche entrants have made their debut and succeeded in establishing a foothold in the industry (e.g. Disney, Oceania, Saga Cruises, Silversea, Viking), but they are often linked to powerful owners or acquired by one of the larger cruise line holdings after several years of operation (e.g. Oceania was purchased by NCLH in 2014, Silversea was purchased by RCG in 2018). These acquisitions have expanded the market presence of the large players and thus further increased their power, reducing the threat of new entrants even more. Thus, **investment costs are not a total barrier to new entrants, but are a significant one**.

The threat of substitutes is moderate-to-low. Cruise trips but have some unique characteristics compared to general tourism, i.e. the ability to visit a number of destinations in a single holiday without the hassle of transferring luggage, travelling between them or checking into different accommodation each time. It also has distinct advantages over sub-segments, such as casinos and theme parks. Cruising also has a customer base that is very loyal to cruising and to individual brands. According to the CLIA 2020 *State of the Cruise Industry Outlook*[26], 82% of respondents to a survey said they were likely to book a cruise as their next vacation. The state of the cruise lines' order books confirms this (e.g. as of January 2021, Carnival's first-half bookings for 2022 had already outpaced 2019 levels[27]). The PRG validated the fact that consumers are likely to book their next cruise trip with the same provider, incentivised by loyalty schemes offering discounts, upgrades and free services and amenities. Thus, **brand loyalty is high both within and across the industry**.

The power of buyers in the cruise market is moderate-to-low. The cost to consumers of switching to another form of tourism is low, suggesting **moderate buyer power**. In practice, loyalty to cruising is high as illustrated in the discussion above on the

[26] https://cruising.org/nl-nl/news-and-research/research/2019/december/state-of-the-cruise-industry-outlook-2020
[27] https://www.carnivalcorp.com/news-releases/news-release-details/carnival-corporation-plc-provides-preliminary-financial

threat of substitutes. Within the industry, the power of buyers is moderate as the cost of switching cruise lines is low and the services on offer are very similar. However, there are costs in forfeiting incentives to brand loyalty, thus **lowering the power of buyers**.

The bargaining power of suppliers is both high and low. It is **high on the product side and low on the service side**. The main product suppliers are the cruise shipbuilders, including Chantiers de l'Atlantique, Meyer Turku, Meyer Werft and Fincantieri.[28] Given the highly concentrated shipbuilding market and the specific capabilities required in building cruise ships, cruise lines have fewer choices than other industries, thus resulting in **high bargaining power for shipbuilders**. Nevertheless, in the past five years, several shipyards have stepped into the cruise market, notably to specialise in small cruise ships, e.g. Brodosplit, Hijos De J Barreras, Metalships, Ullstein, Vard, WestSEA.[29] From a service perspective, **the bargaining power of suppliers of food and entertainment options is low,** as there are a wide range of suppliers.

Intensity of rivalry among firms is one of the main forces shaping an industry's competitive structure. The higher the intensity of rivalry, the more competitive the industry, and the less attractive the industry for new players. **Rivalry amongst existing players is high**. The rapid growth and aggressive acquisitions in the cruise lines market over the last decade are signs that existing players are competing vigorously with each other. Intense rivalry should drive down prices and decrease the overall profitability of the industry. The barriers to new entry from their economies of scale, capital expenditure costs and their incumbency advantage) decrease the threat. Moreover, cruise lines have moved to competing more on value for the client instead of purely on price. **By diversifying and innovating, the large players have managed to secure their positions and sustain their long-term growth.**

2.4 Findings

The cruise industry globally, which is dominated by four players who account for more than 90% of revenues, is well placed to and is likely to continue to grow. This is **a structurally attractive industry which has little to fear from new entrants** because of the high capital costs of new ships, high levels of rivalry and high levels of service. It has a customer base that is loyal to cruising and loyal to brands. This locks in its market in combination with the fact that no other tourism offers the same unique features. The industry is in a position of strength in negotiating with service suppliers, but not necessarily with the main product suppliers, the shipbuilders. Rivalry between the four main players is considerable, but they are succeeding in competing on value and the experience rather than on price.

[28] https://cruiseindustrynews.com/cruise-ship-orderbook/
[29] https://cruiseindustrynews.com/cruise-ship-orderbook/

CHAPTER 3: CRUISE TOURISM - RESILIENCE OF DEMAND

3.1 Introduction

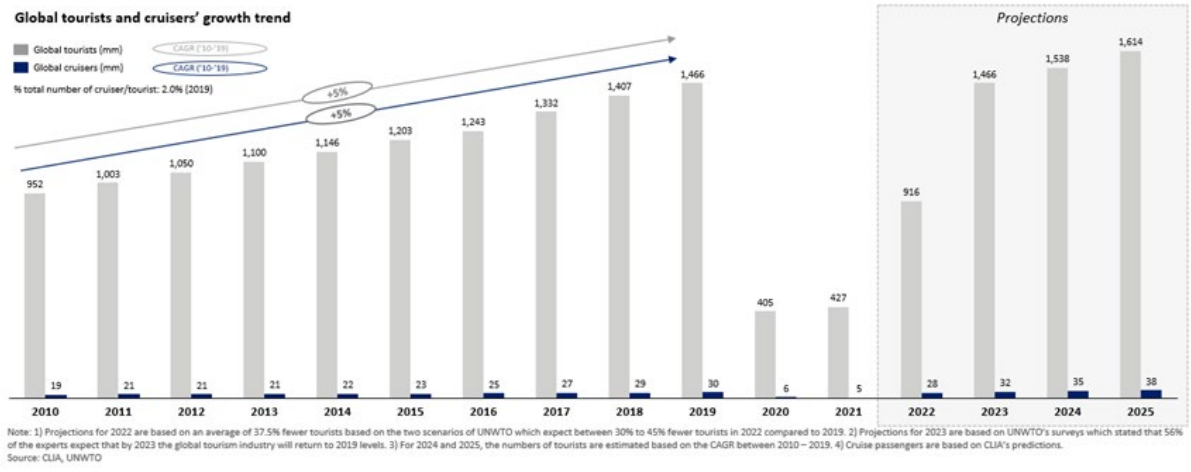
The previous chapter looked at the resilience of supply, in particular the position of the four major players and their structural attractiveness, and thus their resilience. Part of that resilience comes from strong demand, which is looked at in greater detail in this chapter. The chapter looks at patterns of growth, patterns of travel and the demographics of the industry's customers. It looks first at the global picture and then at the EU.

3.2 Global demand and voyage patterns

Cruise tourism is a growth industry and is projected to continue growing once it recovers from the impact of COVID-19 (and subject to it not being subject to major external shocks.) Global tourism and cruise tourism are expected to be back at 2019 levels by 2023 and to continue growing strongly after that according to projections made in September 2021 based on data from S&P Capital IQ and Statista.[30]

On average cruise passengers constitute less than 2% of the entire tourist population; the number of passengers group is growing at the same speed as the entire tourist population (CAGR: ~5%). The two factors have been positioned in one Figure (Figure 13) so that a comparison can be made. The projections do not take into account the impact of the war in Ukraine on some sources of demand, some destinations and European economies. These could slow recovery.

Figure 13 Global tourist and cruise passenger growth trend



Source: Deloitte/Ramboll analysis

[30] The number of tourists in 2020 was calculated based on the ratio of the total number of cruisers to tourists over the period of 2010-2019. For 2021, the number of cruisers was calculated based on the industry average revenue projection trend, under the assumption that the growth in the number of cruisers is directly proportional to the revenue of the industry. For 2022, the number of tourists and cruisers was interpolated based on their projected compound annual growth rate (CAGR) between 2021 and 2023, assuming exponential growth between the years as operations return to pre-COVID-19 levels. The projection for 2023 was based on an assumption by the WTO (UN World Tourism Organization) that, by the end of 2023, the level of cruise tourism will have returned to 2019 levels. For 2024 and 2025, the number of tourists and cruisers is estimated based on the CAGR between 2010 and 2019. The projections for global tourism numbers for 2021 proved to be close to the actual tourism numbers.

Even without disruptive factors that have emerged since the pandemic abated, there is nevertheless **a possibility that this forecast may be lagged by one year or more**. Nearly half the experts interviewed for a June 2021 UNCTAD report *COVID-19 and Tourism an Update* envisaged a return to 2019 levels in 2024 or later That report predicted that the recovery of the sector would vary by region and by country due to regulation and the speed of vaccination roll-out, with potential virus variants as a potential complicating factor. According to data published by the WTO in July 2021[31], world destinations recorded fewer tourists in the period to May 2021 compared to the same period in 2020. However, the data does show an upturn, reflecting the easing of restrictions and rising consumer confidence.

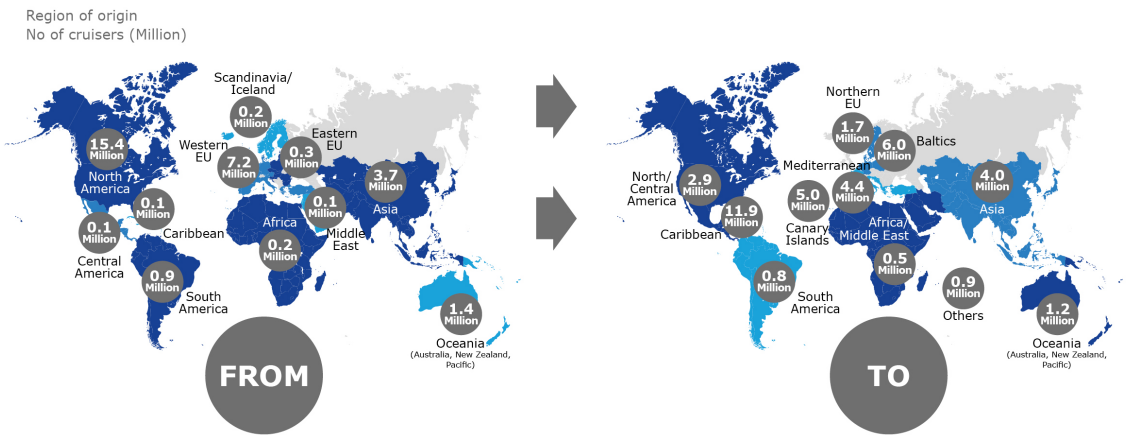
This study assumed that similar trends would follow for cruise passengers. While, caution is advised because the perception of cruise lines was negatively affected by the COVID-19 outbreaks on board cruise ships, according to a consumer survey conducted by the CLIA in 2020, 75% of respondents who had cruised before were very likely or likely to cruise again, compared to 79% in 2019.[32] As the survey pointed out, these findings show a remarkably small divergence in responses and suggest only a very modest shift in sentiment.

The recovery of cruise tourism has been helped by the fact that many cruise companies offered credits that could be used for future bookings, instead of cash refunds, and/or offered large discounts for new bookings. Consequently, there is **consensus that there will be a recovery to pre-COVID-19 levels, but uncertainty about whether this will be in 2023 or 2024.** COVID-19-related factors on which this will or have depended include vaccination rollouts, consumer confidence, border regulation, etc. There is also a distinction to be made between tourism and cruise tourism, however. Unlike air travel, cruise ships have a flexibility not available to other parts of the industry in being able to move around and re-deploy to regions that have re-opened and are most profitable.

The impact of external shocks depends on where cruise tourists originate and travel to. External shocks that hit North America or Europe as origins, or the Caribbean or Mediterranean as destinations will have a significant impact, but that impact may be limited depending on whether the shock is limited to a specific region (Figure 14).

[31] https://www.unwto.org/international-travel-largely-on-hold-despite-uptick-in-may
[32] CLIA internal survey

Figure 14 Origins and destinations of cruisers, 2019



Source: Deloitte/Ramboll analysis

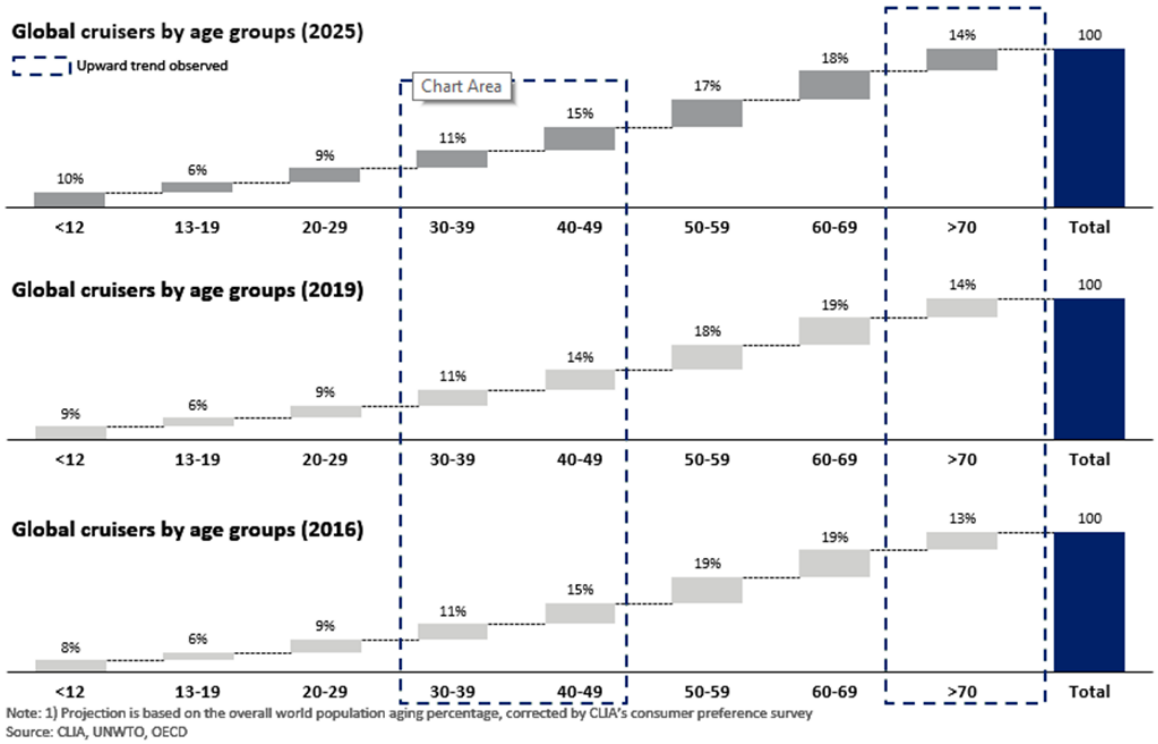
The demographics of global demand

The cruise industry has a natural demand advantage in remaining resilient in that most of its demand comes from a growing demographic, the older age groups (as can be seen in the >70 age group in Figure 15). According to World Population Prospects 2019[33], by 2050, 1 in 6 people in the world will be over the age of 65, up from 1 in 11 in 2019.

Cruising is not just for an older age group. The median age of cruise passengers in 2019 remained consistent at 46.7 years compared to previous years, according to the CLIA[34]. As Figure 15below based on confidential CLIA data show, around one-quarter of cruise passengers are between 30 and 49, and this is one of two growth segments looking ahead to 2025 along with the over-70's.[35] However, **the difference in the size of market segments as between 2016, 2019 and 2025 is marginal**.

[33]https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf
[34] https://cruising.org/-/media/research-updates/research/clia-global-passenger-report-2018.ashx
[35] The projection is based on the overall world population ageing percentage, corrected based on CLIA's consumer preference survey.

Figure 15 Global cruise passengers by age group (2016, 2019, 2025)



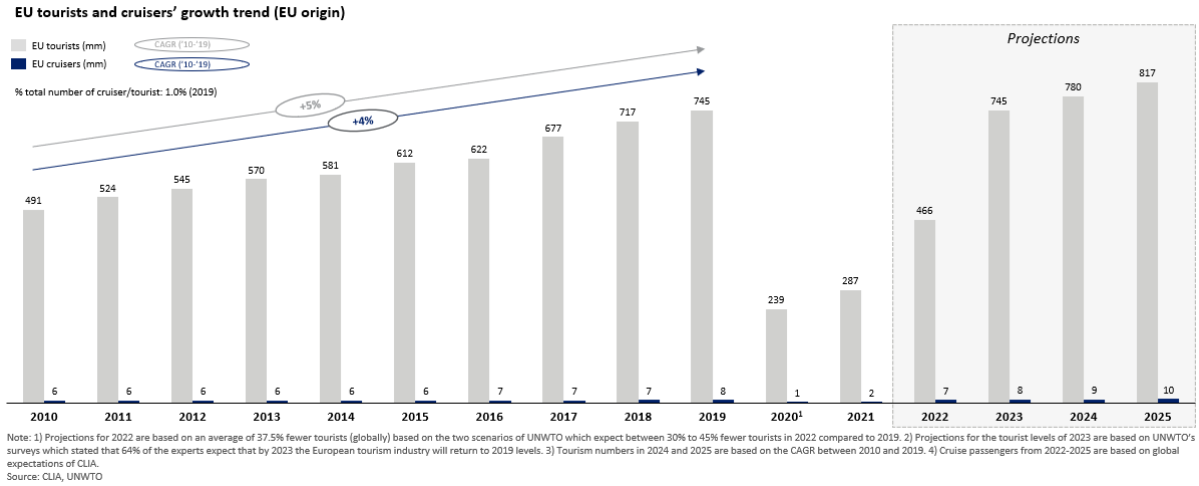
3.3 EU demand and voyage patterns

The same analysis was conducted for EU-27 tourists and EU cruise passengers (by origin) as for global tourism. EU cruise passengers on average make up ~1% of the total EU tourist population. While the actual number of EU cruise passengers in 2020 has been confirmed to be 1.35 million[36] since the calculations were made, instead of 2 million as calculated by the consortium, this does not change the **assumption that by 2023, demand will have returned to 2019 levels** (

Figure 16)**, and then continue to grow strongly in the following two years.** As the projections were made in 2021, factors which have emerged since then, such as the war in Ukraine and economic recession, are not reflected in the data.

[36] https://www.statista.com/statistics/386688/number-of-cruise-passengers-in-europe/

Figure 16 EU-27 tourist and cruise passenger growth trend (EU origin)



Source: Deloitte/Ramboll analysis

The **initial signs were promising**, however. According to a study conducted by European Travel Commission in July 2021[37], improvements in vaccination rates were continuing to strengthen the upside potential for Europe. The introduction of COVID-19 certificates and the gradual reopening of the EU to fully vaccinated travellers offered room for some momentum ahead. Intra-European travel was expected to bolster travel demand in the second half of 2021, with an improving epidemiological situation across Europe enabling governments to ease restrictions and satisfy people's desire to travel again. This forecast showed that intra-European travel would account for 83% of Europe's inbound arrivals in 2021 compared to 77% in 2019.

As with global cruise tourism, the impact of external shocks is highly dependent on where cruise tourists originate and where they travel to, it is clear that cruise companies dependent on the European market are vulnerable to external shocks affecting Germany and the UK as source countries and the Western and Central Mediterranean and northern Europe as destinations (Figure 17).

[37] https://etc-corporate.org/reports/european-tourism-2021-trends-prospects-q2-2021/

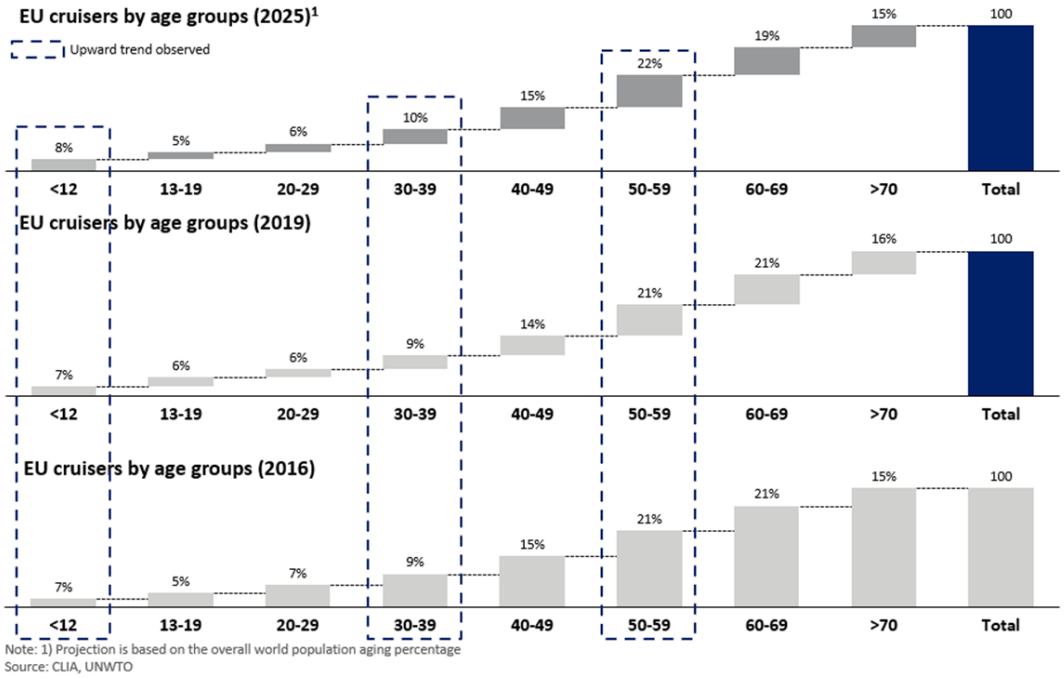
Figure 17 Origins and destinations (EU-27 and the UK)

Source: Deloitte/Ramboll analysis

The demographics of EU demand

Demographic trends in the EU are similar to global trends and the demand patterns are similar. One quarter of the demand comes from the 30-49 age group (Figure 18). The areas of growth are slightly different, i.e. the under-12's, the 30-39 age group and the 50-59 age group, but the degree of change between each age group and the differences with global patterns are marginal. EU cruisers will moreover remain less likely to travel with under-12's than the global average. There are differences in the growth potential for the traditional demographic, however. The change for the 60+ group at a global level is on average +14.8% from 2019 to 2025, compared to the EU-27 level, where the change is +9.8%.

Figure 18 EU-27 cruise passengers by age group (2025)



In addition, the prospects in the Gen X and millennial market appear to be good. According to an internal CLIA survey in May 2021, 82% of Gen X respondents and 85% of millennials who have already taken a cruise are likely to cruise again. Of those who had never taken a cruise, 62% of Gen X and 71% of millennials were likely to cruise in the next few years. According to the CLIA's 2020 *State of the Industry* report, 66% of Gen X and 71% of millennials at that time had a more positive attitude to cruising than in 2018[38].

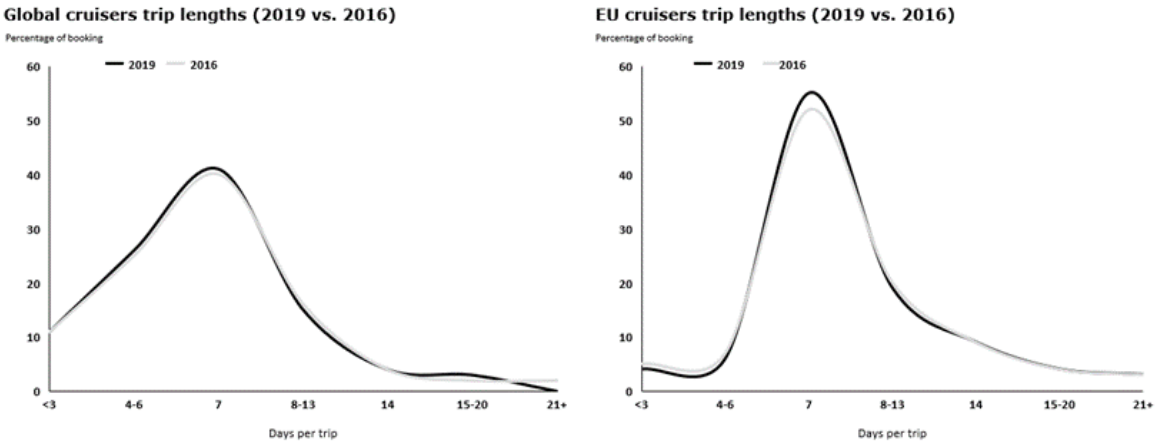
This has implications for the service offering. A Deloitte cruise industry analysis[39] conducted in the US in 2017 found that younger generations who rate cruises as their favourite type of vacation are demanding enhanced features and a wider array of unique experiences. As millennials embark on their first cruises, they have an appetite for heightened personalisation and customisation compared to prior generations. In response, cruise operators are seeking to outdo the competition by adding more and more unique attributes to ships.

Length of trip

A characteristic that both the global and EU markets share is an average trip length of 7 days, a characteristic that remained stable between 2016 and 2019, with no reason to believe that it might change in future. However, the seven-day peak is much more pronounced in the case of EU cruisers (Figure 19) and **EU cruisers are more likely to take longer cruises. Globally, there are far more short-break cruisers**.

[38] https://www.cruisetradenews.com/ctn-investigates-cruise-attract-younger-passengers/
[39]https://www2.deloitte.com/content/dam/Deloitte/us/Documents/consumer-business/us-cruise-industry-analysis-passenger-experience.pdf

Figure 19 Trip length by global and EU cruise passengers (2019 vs. 2016)



Source: Deloitte/Ramboll analysis

3.4 Findings

Demand for cruising is vulnerable to external shocks as COVID-19 illustrated but is expected to bounce back to pre-COVID-19 levels by 2023 or 2024, depending on the speed of recovery from the pandemic. Additional external shocks, such as the war in Ukraine and its economic repercussions, could affect those time frames, particularly in some markets. Subject to that proviso, the industry appears to have weathered the COVID-19 storm. Growth in demand appears strong out to 2025, with the industry set to benefit from growth in the older demographic, a strong mid-age segment and a promising outlook among Millennials and Gen-X.

The overall picture on both the supply side (previous chapter) and the demand side is therefore one of a resilient industry well positioned to tackle the challenges of sustainability.

CHAPTER 4: CRUISE TOURISM - THE ECONOMIC IMPACT IN EUROPE

4.1 Introduction

Cruise tourism contributes economically and socially to a destination by generating economic activity through passenger spend, cruise line expenditure and crew spend. This further stimulates the local sectors with revenue and creates jobs both on-shore and off-shore.

The economic impact of cruising is therefore important context for understanding why tackling the environmental and social challenges described in the next two chapters needs to be a high priority. Cruise tourism may be a niche within the EU blue economy and within the tourism industry, but it is an important and growing one, and its relatively small size is not a reason for underestimating its impact on sustainability and growth. As a sub-sector of coastal tourism, it is particularly vulnerable to ups and downs in economic growth,[40] and not only at times of such as obvious crisis as COVID-19.

This chapter **quantifies the economic impact of the tourism industry and the European cruise industry's main segments** – cruise lines, passengers and crew, which drive the other impacts. It shows that it is a EUR 2 billion industry based solely on the combined impact of the cruise lines themselves, their passengers and their crew.

4.2 Cruise tourism as a significant sub-sector of tourism

Tourism has a vital role in job generation, export revenues, and national added value. It accounted for of 10.3% of Gross World Product in 2019 according to the World Travel and Tourism Council.[41] Tourism accounted for one in every 10 jobs worldwide.

In 2018, the EU 'travel and tourism' sector directly contributed 3.9% to EU GDP and accounted for 5.1% of the total labour force (some 11.9 million jobs). When its close links with other economic sectors are taken into account, the tourism sector's figures increase significantly (10.3% of GDP and 11.7% of total employment, which equates to 27.3 million workers).[42]

According to figures published by CLIA in the *Economic Contribution of the International Cruise Industry Globally in 2019 report*, the cruise industry overall contributed EUR 64.5 billion[43] to the European economy in 2019. This represents an increase of 34.7% compared with 2017. The direct expenditure by the cruise industry was EUR 28.8[44] billion in 2019, up from EUR 19.7 billion in 2017 (46% increase). The Mediterranean destinations contribute a significant portion to this amount as they are responsible for 60% of cruise traffic[45]. According to *Cruise Europe* data, the cruise industry accounted for 413 900 full-time jobs in 2019[46]. The sector's growth, according to the CLIA, has mainly been the result of **more Europeans choosing a cruise holiday, more cruise passengers travelling in Europe, and the construction of more cruise ships in EU shipyards**. As a result,

[40] *Blue Economy Report 2022*, p. 18; https://op.europa.eu/en/publication-detail/-/publication/156eecbd-d7eb-11ec-a95f-01aa75ed71a1
[41] https://wttc.org/research/economic-impact
[42] https://www.europarl.europa.eu/factsheets/en/sheet/126/tourism#:~:text=The%20tourism%20industry%20is%20a,committed%20to%20reviving%20this%20sector.
[43] Conversion rate: 1 EUR = 1 USD
[44] The Economic Contribution of the International Cruise Industry Globally in 2019, CLIA (2020), conversion rate: 1 EUR = 1 USD
[45] Trends and perspectives in the EuroMed Cruise Tourism, CLIA (2022)
[46] https://www.cruiseeurope.com/site/templates/images/ce-fact-sheet-economic-impact.pdf

- **Europe is the world's second-largest source passenger market** – 7.7 million Europeans went on a cruise holiday in 2019, 7.5% more than in 2018[47];

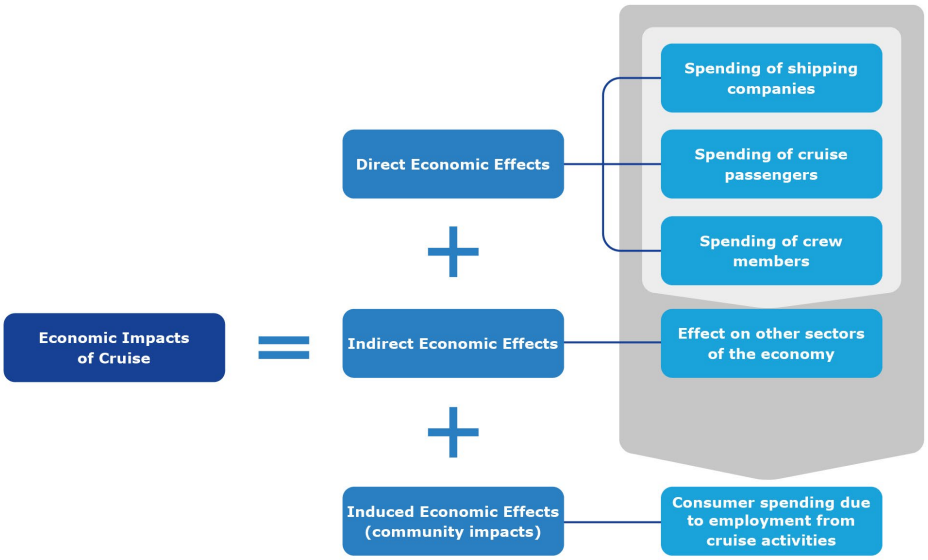
- **Europe is the world's second most popular cruise destination**, second to North America (foremost the Caribbean). 7.6 million passengers embarked on their cruises from European ports in 2019, 8.6% more than in 2018[48];

- **European shipyards are the heart of the world's cruise shipbuilding industry**. They build the world's most innovative and largest ships, with spending on new builds and maintenance increasing. In 2017, cruise lines spent EUR 5.6 billion in European shipyards, representing a 22.4% increase compared to 2015.

4.3 Methodology for calculating the economic impacts

The economic analysis model used here to calculate the direct, indirect, induced or community-level economic effects of the European tourism industry is based on **a combination of inputs and assumptions**, where national input data was not available (Figure 20). In order to provide a typical picture, the economic impact of the EU-27 cruise tourism industry overall was computed both for 2019 (pre-COVID-19 year) and 2020 (COVID-19 year).

Figure 20 Calculating the economic impact of the cruise sector



Source: Deloitte/Ramboll analysis

The coefficients for the direct, indirect, and induced economic effects were computed using the most recent national Input-Output tables maintained by OEC.[49] If unavailable, the closest reasonable alternative or a more generalised table was used (such as an EU-wide option for European countries).

The total number of passengers in EU ports was around 1.35 million[50] in 2020, whereas it was around 7.7 million in 2019. **The number of port calls was 4 833** in

[47] CLIA 2020 Europe Market Report
[48] The Economic Contribution of the International Cruise Industry Globally in 2019, CLIA (2020)
[49] https://www.oecd.org/sti/ind/input-outputtables.htm
[50] https://cruising.org/en-gb/news-and-research/research/2021/june/clia-europe-passenger-report-2020

2020,[51] and the assumed spending per passenger is EUR 74.[52] All other inputs were unavailable and thus the model utilised assumed estimates. The input-output tables of the EU economy used 2019 Eurostat data. Due to the COVID-19 pandemic, more recent data estimates (2020-2022) were not available in their entirety at the time of writing of this report. However, 2019 as this was the last "business-as-usual" year, it therefore made sense to use this as benchmark for the future. As pointed out previously, the industry was expected at the time of writing this study to recover substantially by 2022-2023 to similar pre-COVID-19 levels.

The complete list of desired inputs included either the total (or average) number of passengers (per ship), the number of port calls per year, the number of crew members present in the port during that year, the average passenger spend, preferably *distinguishing between turnaround and transit passengers*, the *average crew member spend*, the *percentage of passengers on turnaround cruises during that year*, and the *average cost for ships of embarking/disembarking*. Many of these data points are not explicitly recorded by ports and are therefore difficult to obtain for most ports. These inputs are italicised in the list above.

The **direct economic effects** consist of the sum of initial spending by the three key actors involved in cruise activity: cruise lines, cruise passengers and the ship's crew.

Cruise lines: The direct spending generated by cruise lines includes all goods and services needed when cruise ships dock at a port. The following expenses are included in this category: services provided by shipping agents; services provided by the cruise terminals (luggage, safety, handling, check-in, etc.); services provided by the Port Authority (including taxes and port fees); technical services such as waste collection and treatment; fuel supply services; food, beverages and drinking water (among other provisions); crew trips and airport charges; medical care for both crew and passengers; and services provided by travel agencies and tour operators. The total spending of cruise ships has been calculated using two inputs: the average cost of ships embarking or disembarking, and the number of calls per year for that port.

Where the average cost per ship is unknown or unavailable, estimates from a 2009 European Commission Study report were use.[53] To embark and disembark passengers, on average at the time of that report, a cruise ship spent approximately EUR 6 per transit passenger and EUR 24 per turnaround passenger (mainly as a result of luggage handling and customs fees). Adjusting this for inflation, it converts to EUR 7 and EUR 28 respectively in 2020. Using the percentage of transit and turnaround passengers, a weighted average figure for the cruise lines' spend per passenger was computed. Multiplying this by the total number of passengers provided an estimate for the yearly spending in port for embarking/disembarking.

The taxes payable to government authorities are not actively accounted for as they are considered part of the spend that will go towards the local economy. This decision was made on the assumption that taxes are a reallocation of the spend, and will be redistributed to the local economy as services, such as infrastructure improvement, waste management, destination management, etc. The spending of these tax revenues cannot be accurately attributed to any industry in the input-output model. In order to compute the indirect and induced effects, government spending would thus have to have belonged

[51] European Maritime Safety Agency; Impact of COVID-19 on the Maritime Sector in the EU, July 2021
[52] Using the 2014 average of 70 and adjusting it for inflation; https://www.researchgate.net/publication/328789045_Recent_Evolution_of_Cruise_Activities_in_European_Ports_of_Embarkation_a_Quantitative_and_Economic_Approach
[53] https://sustainableworldports.org/wp-content/uploads/PRC-Tourist-facilities-in-ports-Growth-opportunities-for-the-European-maritime-economy-economic-and-environmentally-sustainable-development-of-tourist-facilities-in-ports-2009.pdf

to the 'Other goods and services' category, which already included ship spending. Thus, for the purpose of this model, the effects of direct spending on taxes are assumed to be included in the cruise lines' direct spending.

Cruise passengers: The direct spending by cruise passengers includes spending on trips, visits to museums and other cultural and entertainment activities; accommodation (hotels, hostels and tourist apartments); expenses (restaurants and cafes); various purchases (electronics, souvenirs, clothing and footwear, etc.); internal city transport (including transfers from the airport/railway station to the port and vice-versa), and airport charges, as applicable. For the rare cases in which the total number of passengers per ship is not known for a certain port, the model allows it to be computed using the number of port calls during the year and the average number of passengers per ship.

The average passenger spend is a necessary input, as different ports have different prices depending on their location. However, if no differentiated inputs can be found for transit and turnaround passengers, the same (average) value can be used for both variables. The percentage of turnaround passengers is also a preferred input, but if unavailable, an average value of 30% is used.[54]

Further assumptions are needed when assigning direct spending to industries. In the 2009 study quoted above on tourist facilities in ports[55], the European Commission presented the results of a large series of surveys across different European cruise destinations. The aggregation of these survey results made it possible to compute the average spending of passengers on various types of goods and services, such as tours, food and beverages, transportation or accommodation. It also differentiated between transit passengers and turnaround passengers, as they spend different amounts on each category. While the average spending differs across Member States, this classification made it possible to assign percentages of the total direct spending to each industry.

Due to a lack of distinct data, it was assumed that these percentages hold across all ports. This, together with the data available on the average spend per passenger and the total number of passengers, made it possible to compute the direct spending of passengers in the port.

Crew: Although not the same spend as that of cruise passengers, the direct spend by the crew in the city includes: expenses (restaurants and cafés); various purchases (souvenirs, clothing and footwear, etc.); and internal transport around the city. In order to compute their spending in various industries, we need to know each crew member's average spend, the number of crew members arriving and (dis)embarking in the port during the year, and their spending patterns.

Crew member data is unfortunately very scarce. Average crew member spend is particularly difficult to find. In the same 2009 study mentioned above, the authors computed an average spend of EUR 25 per disembarkation[56]. This is compared to the average passenger spend. At a turnaround rate of 30%, the crew spend is also 30% of the passenger spend. However, according to that study only about 50% of crew members disembark in a port. For most cases where this data is not specifically available as an

[54]Based on https://www.statista.com/statistics/629256/mediterranean-cruise-home-in-out-vs-transit-passengers-by-region/ and various national reports

[55] https://sustainableworldports.org/wp-content/uploads/PRC-Tourist-facilities-in-ports-Growth-opportunities-for-the-European-maritime-economy-economic-and-environmentally-sustainable-development-of-tourist-facilities-in-ports-2009.pdf

[56] https://sustainableworldports.org/wp-content/uploads/PRC-Tourist-facilities-in-ports-Growth-opportunities-for-the-European-maritime-economy-economic-and-environmentally-sustainable-development-of-tourist-facilities-in-ports-2009.pdf

input, the assumed estimate of the crew spending is computed as a percentage of passengers' spending.

For many ports, it is also impossible to retrieve data about the total number of crew members arriving in a port. In those cases, the number is estimated using the passenger-to-crew ratio. The specific value assumed is 2.67, which is based on a global average calculation.[57]

In order to assign the average spend to certain goods and services, we assume that crew members spend 40% of their budget on food and beverages, 50% on shopping, and 10% on transportation.[58]

Secondly, the **indirect impact** is the effect on other sectors of the economy generated as a result of the goods and services required by the companies that are receiving direct expenditure. For example, for a hotel to accommodate a cruise passenger, it also needs to purchase a set of goods (such as textiles, food products, etc.) and services (cleaning, transportation, etc.) Similarly, companies providing moorings and pilot boats require a range of goods and services to carry out their activity in port based on the cruise companies. In turn, these 'second-order' providers require goods and services for the development of their activity and so on. Production in all sectors is influenced by the direct spending by cruise lines, cruise passengers and crew, thereby generating a multiplier effect throughout all economic sectors.

The **induced impact** is the effect derived from consumer spending of revenue-generated employment (directly and indirectly) in cruise activities. People who occupy these jobs owe them directly or indirectly to cruise activity in the city. These people receive a wage income that is allocated in part (after deducting taxes, contributions and savings) to consuming goods and services in their place of residence/work. This thus reactivates a chain of intersectoral relationships that leads to an increase in the turnover of different economic sectors.

In the context of the current study, the induced effects, due to their complex nature, are linked to the broader community-level economic effects of the cruise industry. This is based on the assumption that, as the purchasing power of people who occupy jobs directly or indirectly related to cruises increases, a portion of those earnings are invested in the broader community, either through consumption or through investment, thereby resulting in broader benefits to the coastal communities.

To quantify the economic impact of cruises, the next step is to define the key economic indicators. Each of these impacts was quantified using the:

- **Turnover** generated by cruises in euro;
- **Gross value added** (GVA) of wage income (as a component of the GVA) in euro;
- **Employment** in full-time equivalent jobs;
- **Tax revenues** for regional, state tax and tourist tax (wherever the data is available).

For the indirect impacts, the methodology of an input-output model was used to identify adjacent sectors. This is an economic model that represents interdependencies between different sectors of a national economy.[59]

[57] https://www.cruisemapper.com/wiki/761-cruise-ship-passenger-capacity-ratings
[58] Based on https://www.ub.edu/irea/working_papers/2016/201613.pdf
[59] For detailed mathematical calculations: https://www.math.ksu.edu/~gerald/leontief.pdf

Direct spending (from the cruise tourists and the crew members) can impact the economy in two ways; by creating a direct value add to the economy, and by incentivising other sectors through indirect and induced impacts.

In the Tables that follow we also show the value added. The direct value added or gross value added (GVA) is the balancing part of the national accounts of a country. It represents the "real" addition of a sector to the economy when all the intermediate consumption effects are removed. These intermediate effects are the contributions of the industry in question (in this case, the cruise tourism industry) towards other sectors (accommodation, transport, entertainment, etc.)[60] By removing the intermediate effects from the economic output generated by direct spending, we can understand the direct value added by cruise tourism. Direct value added is always less than direct spending as it is only one component of the economic impact. Therefore, for the overall economic impacts, we use direct spending, as opposed to direct value added to provide a complete picture, i.e. the total economic impact in the tables is the total of direct spending, indirect and induced effects as per Figure 20.

Table 4 shows the economic impact of the cruise sector on the EU-27 in 2019 and 2020, illustrating clearly the impact of COVID-19. The total economic impact in 2020 was only 15.9% of the 2019 level. The impact was broadly the same across the four sub-categories in Table 4, either 15.8% or 15.9% depending on the category.

Table 5 breaks the impacts down between cruise lines, passengers and crew. In this case the least impact is on the cruise lines (relatively speaking), with the impact in 2020 at 17.5% of 2019 levels. For passengers and crew, the figure is 15.6% each time.

[60] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Gross_value_added

Table 4 Economic impact of cruises on EU-27 economy

	2019	2020
Direct spending	809 153 996	128 678 637
Direct value added	*646 579 230*	*102 736 063*
Indirect effect	547 131 614	86 267 177
Induced effect	646 604 229	102 429 939
Total economic impact	**2 002 889 839**	**317 375 753**

Source: Deloitte/Ramboll analysis

Table 5 Breakdown of economic impact of cruises on the EU-27 (EUR)

		2019	2020
Cruise lines	Total spending	136 800 042	23 909 388
	Value added	*104 642 652*	*18 289 043*
	Indirect effect	53 327 497	9 320 376
	Induced effect	88 284 215	15 429 978
	Total economic impact	**278 411 754**	**48 659 742**
Passengers	Total spending	639 681 000	99 678 000
	Value added	*512 754 886*	*79 899 796*
	Indirect effect	469 853 880	73 214 767
	Induced effect	530 044 467	82 593 937
	Total economic impact	**1 639 579 347**	**255 486 804**
Crew	Total spending	32 672 954	5 091 248
	Value added	*29 181 692*	*4 547 224*
	Indirect effect	23 950 236	3 732 035
	Induced effect	28 275 547	4 406 024
	Total economic impact	**84 898 747**	**13 229 307**
Total	Total spending	809 153 996	128 678 637
	Value added	*646 579 230*	*102 736 063*
	Indirect effect	547 131 614	86 267 177
	Induced effect	646 604 229	102 429 939
	Total economic impact	**2 002 889 839**	**317 375 753**

Source: Deloitte/Ramboll analysis

From Table 5, it can be seen that passengers account for by far the most economic impact, i.e. 82% of the total, compared to 4% for the crew and 14% for the cruise lines.

4.4 Findings

In a 'normal' year, taking the last pre-COVID year, i.e. 2019 as a benchmark, Europe's cruise tourism industry adds more than EUR 2 billion to the EU economy, of which more than four fifths is contributed by the passengers, one sixth is from the cruise lines and the remainder from the crew. That contribution dropped by nearly 85% in 2020, underscoring the vulnerability of this important sub-segment of the tourism industry to external shocks.

CHAPTER 5: CRUISE TOURISM - ENVIRONMENTAL CHALLENGES

5.1 Introduction

As a highly visible part of the marine industry, the cruise sector is something of a lightning rod for criticism of the environmental impact of shipping. This could be considered disproportionate when considering that cruise ships make up less than 1% of the global maritime fleet[61] and its emissions represent roughly 2.5-3% of global shipping emissions (Figure 21). Nevertheless, **the sector has a responsibility that it already recognises to address those emissions.**

The cruise tourism industry, as of 2021, had invested over USD 26.3 billion in a variety of onboard and portside technologies as well as cleaner fuel sources to reduce the environmental impact of new ships[62], for example. It is now common practice for major cruise lines to publish annual sustainability reports. More than 100 European ports are members of the European Sea Port Authority's (ESPO) EcoPorts network, the main environmental initiative of the European port industry. More than 70% of these ports are certified with an internationally recognised environmental standard (ISO 140001, Port Environmental Review System (PERS) or Eco-Management and Audit Scheme (EMAS)).[63]

Many challenges remain. Technological solutions to these often exist or are on the horizon, but one of the key challenges is choosing which to invest in and which to prioritise, particularly when other, better technologies may be just over the horizon. This chapter discusses the **challenges. The next chapter looks at potential possible solutions, with a view to supporting decisions on no-regrets investment measures.**

The challenges even when concentrating on the direct environmental impacts are complex. Ships emit to the air, discharge to the sea and have downstream impacts on land at their destinations, in port and on local tourism ecosystems (Figure 22). This chapter focuses on the ships themselves and their activities on land (in port). The broader destination impacts are discussed subsequently.

While emissions are produced across the cruise tourism industry, the emphasis in this chapter is on emissions from cruise ships due to the lack of readily available data covering scope 2 and 3 emissions (i.e. indirect emissions from energy purchased for consumption and other indirect emissions).

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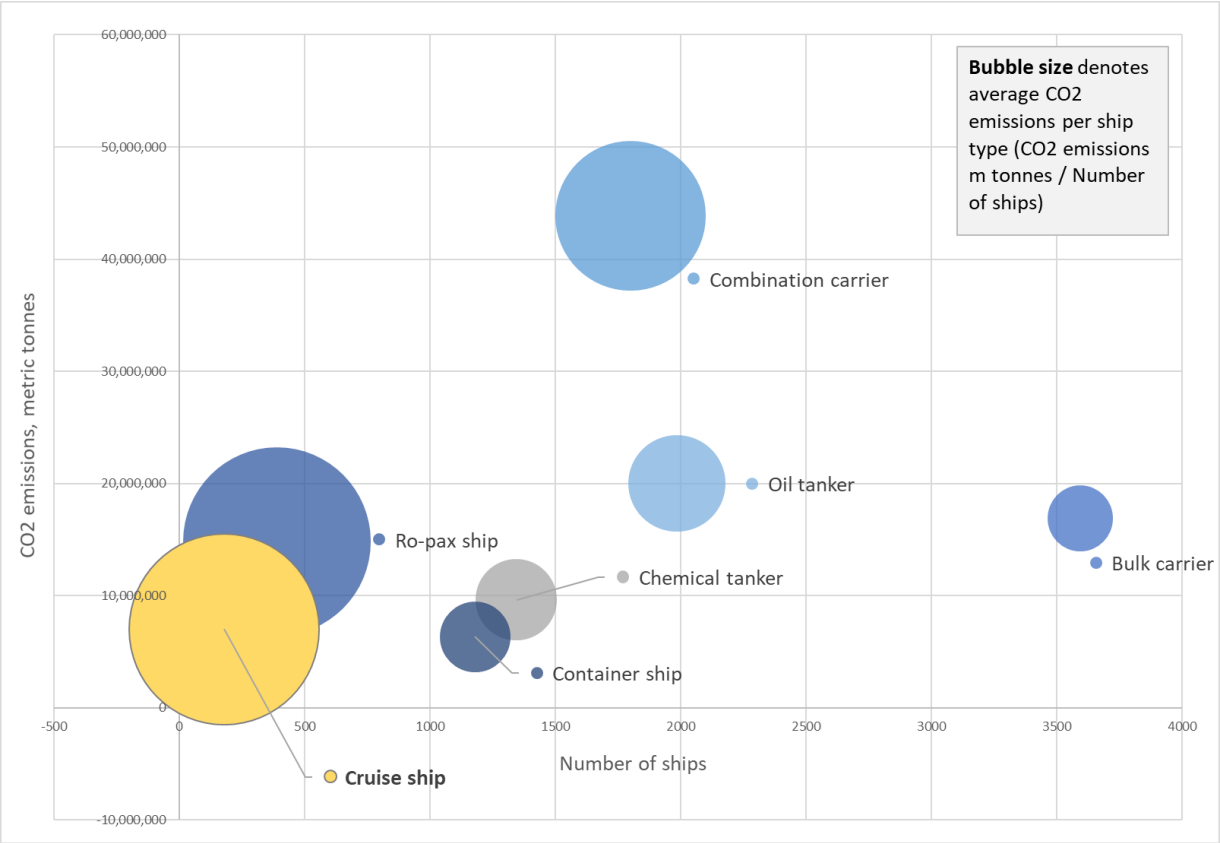
[61] Oxford Economics. 2020. *Environmental commitment, innovation, and results of the cruise industry*: report produced for Cruise Lines International Association (CLIA). Cruising.org; https://cruising.org/-/media/research-updates/research/clia-environmental-study-report.ashx

[62] Oxford Economics. 2021. *Environmental commitment, innovation, and results of the cruise industry*: report produced for Cruise Lines International Association (CLIA). Cruising.org; https://cruising.org/-/media/clia-media/research/2021/economic-impact/clia-env-study---11-01-2021---final.ashx

[63] European Sea Ports Authority (ESPO). 2019. ESPO Statement on safeguarding the development of sustainable cruise activity in European ports/ https://www.espo.be/media/ESPO%20Statement%20on%20safeguarding%20the%20development%20of%20sustainable%20cruise%20activity%20in%20European%20ports_1.pdf

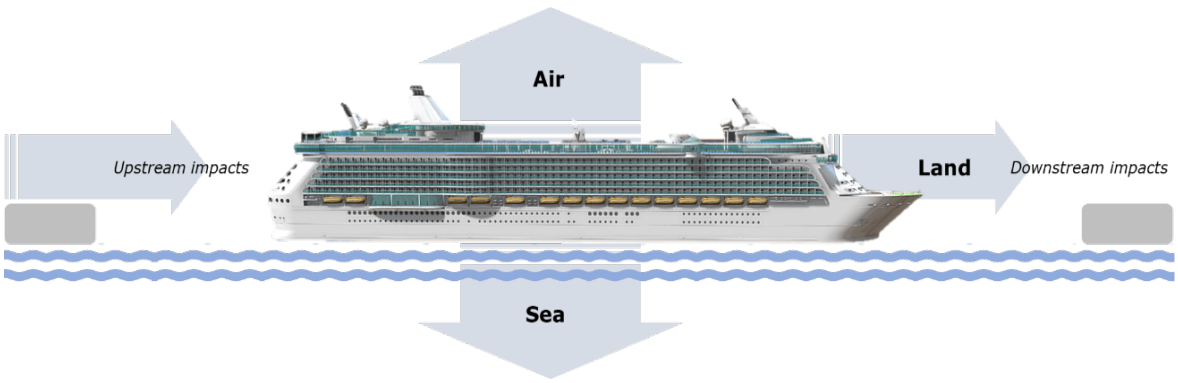
Figure 21 Total CO2 emissions in relation to number of ships, by ship type (2019)



Source: Adapted from https://ec.europa.eu/clima/system/files/2020-05/swd_2020_82_en.pdf

Note: Cruise ships are illustrated in yellow.

Figure 22 Schematic overview of environmental impacts



Source: Deloitte/Ramboll analysis

5.2 Where the challenges lie

The following section describes the main challenges from emissions to the air, to the sea from waste (waste water and solid waste), from issues such as biofouling, and other challenges, including noise and the impact of dredging. It describes schematically **how relevant the challenge is, the extent of the problem, recent trends and the extent to which mitigation measures are available**.

In many cases, there is no data for the cruise industry as such and the implications must be extrapolated from the shipping industry as a whole. Cruise ships will have a greater or lesser impact depending on the ships' characteristics. For example, the impact of measures to deal with trim are not as critical for cruise ships as for a cargo-carrying vessel; cruise ships are thought to be the lowest contributor to this impact in relative terms. The large number of passengers and crew, on the other hand, means that cruise ships are likely to have a disproportionate impact on the food waste and sewage produced. The data in the next section should be read with that in mind.

5.2.1 Emissions to air

Targeting emissions from fuel, notably CO2, SOx, NOx and particulate matter, is a high priority for the EU to combat climate change and the impact on human health of air pollution.[64] In cruise ships, the extent of the emissions depends on variables such as the size of the vessels and the age of the equipment, which determine the power needed and the type of fuel used.

The biggest factor is propulsion: via the main engines (ME), via the auxiliary engines (AE), and steam generation via auxiliary boilers (AB) to power on-board operations. According to MSC Cruises, propulsion of their cruise ships accounts for around 60% of their carbon emissions[65]. Aside from propulsion, systems such as those powering heating, ventilation and cooling (HVAC) on board are all energy-intensive.

Currently, the maritime industry mainly uses two fossil fuels, **heavy fuel oil (HFO) and marine gas oil (MGO)**. HFO is generally already used in the cruise tourism industry in conjunction with mitigating measures such as exhaust gas cleaning systems (EGCS)[66]. A low sulphur form of MGO (LS MGO) is used to meet the specific restrictions in some areas, such as the Baltic.

Emissions can be exacerbated by inefficient use of cruise propulsion systems and by hull biofouling, which is discussed in more detail subsequently.

[64] European Commission. 2021. Proposal for a regulation on the European Parliament and of the council on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC. https://ec.europa.eu/info/sites/default/files/fueleu_maritime_-_green_european_maritime_space.pdf
[65] MSC Cruises. 2020. Charting our sustainable future: 2019 sustainability report. http://viewer.zmags.com/publication/ad7ec97d#/ad7ec97d/24
[66] Cruise ships utilising HFO are required to meet global sulphur emission requirements of 0.50% (5000ppm) and Emission Control Area requirements of 0.10% (1000ppm).
[67] Teleconference interview conducted 19/05/2021.

Carbon dioxide (CO2)

Aerosol emissions (particulate matter)

Sulphur oxides (SOx)

Nitrogen oxides (NOx)

5.2.2 Waste

Wastewater

Not only are cruise ships large with large numbers of passengers on crew on board, but they tend to operate in sensitive marine environments. This **can make the cumulative impact of their waste significant**. One of the most significant forms of waste is wastewater of which there are four types: black water, grey water, ballast water and bilge water.

Black water: This is water flushed down toilets as well as medical facility water, i.e. sewage. Some estimates suggest that cruise ships produce up to 40 litres of sewage per person per day.[68] This is not only a health hazard to humans but to aquatic life.[69] Eutrophication resulting from black water discharges is considered a major problem in the Baltic Sea.[70]

Only some of this is untreated, however, as discharges are regulated and CLIA members are banned from discharging untreated black water at sea under normal operating conditions.

Grey water: This is wastewater that is incidental to the operation of the ship, e.g. from activities such as laundry, showers, washing in sinks and wastewater from kitchens. According to a report from the Baltic Marine Environment Protection Commission (HELCOM)[71] cruise ship greywater generation is approximately 120 litres per person/day.

Discharging untreated grey water degrades the quality of the waters into which it is discharged. Grey water is not covered by international regulations, and there is no requirement to treat it before discharging it into the sea since it does not contain bacteria as harmful as those found in raw sewage (black water). Many leading cruise lines do treat grey water (e.g. through simple filtration methods).

Bilge water: This may contain oil, grease, or other contaminants that have dripped from various sources such as shaft seals, evaporators or other machinery. It is the most common source of oil discharges from cruise ships. On most cruise ships, oily bilge water is managed either by retaining it onboard in a holding tank and discharging it later to an onshore reception facility or treating it onboard with an Oily Water Separator (OWS).

Globally, chronic pollution from bilge water and fuel released in standard ship operations accounts for as much as three times more pollution than reported acute oil spills and collisions,[72] despite international regulations.[73] According to the US Environmental Protection Agency (EPA), the chemical contaminants in oily bilge water can poison marine life and cause chronic disease, reproductive failure and deformities – ultimately impacting the survival rates of the affected marine species.[74]

[68] EMSA. 2021. European Maritime Transport Environmental Report (EMTER) 2021. https://www.eea.europa.eu/publications/maritime-transport
[69] Friends of the Earth. 2020. 2020 Cruise Ship Report Card. https://1bps6437gg8c169i0y1drtgz-wpengine.netdna-ssl.com/wp-content/uploads/2020/09/Cruise-Report-Card-2020_Final.pdf
[70] Teleconference interview conducted 18/06/2021.
[71] Hanninen, S., and J. Sassai. 2009. Estimated Nutrient Load from Wastewaters Originating from Ships in the Baltic Sea Area (Research Report VTT-R-07396-08).
[72] Clark, R., 2006. Marine Pollution, 5th ed. Oxford University Press Clarendon Press, Oxford, UK.
[73] MARPOL Annex I requires discharged bilge water to contain less than 15ppm of oil.
[74] EPA. 2008. Cruise Ship Discharge Assessment Report. https://nepis.epa.gov/Exe/ZyPDF.cgi/P1002SVS.PDF?Dockey=P1002SVS.PDF

Ballast water: Ballast tanks containing sea water or wastewater contribute to ensuring a balanced and consistent weight, centre of gravity and stability throughout the voyage, and reduce the hull stress caused by harsh sea conditions. However, with this practice comes a problem: microscopic organisms and pathogens that can potentially be brought into the ballast tank from one environment and discharged into another[75], making the ship a vector for the transfer of invasive alien species (IAS) between ecosystems as the ship travels between destinations. If suitable conditions exist in this release environment, these species will survive and reproduce, and may come to dominate and displace native species, adversely affecting local marine biodiversity, public health and local economies based on fisheries.[76]

Solid waste

Solid waste generated by the cruise tourism industry can either be **non-hazardous or hazardous**. It mostly comprises non-recyclable material (non-recyclable plastics, recyclables (such as recyclable plastics, glass and paper), food waste, and incineration residue (ash).

The impact of solid waste depends on how it is managed. Solid waste that is poorly managed or discharged directly **can pose a threat to water quality, marine organisms, as well as humans, coastal communities, and other businesses** that use marine waters. Food waste from cruise ships, even if collected on board effectively and landed at ports for landfill, may harm the environment as decomposition of food from any source in landfill gives off methane gas, a greenhouse gas.

Many cruise operators manage their solid waste on board (including incinerating or pulping it) before discharging it overboard or transporting it ashore for disposal or recycling. Several major cruise liners have installed or are planning to install onboard food processing and biodigester plants to minimise the hazard. They have also begun appointing onboard environmental compliance officers, with a focus on source reduction, waste minimisation

[75] EMSA. 2021. Ballast Water Overview. http://www.emsa.europa.eu/we-do/sustainability/environment/ballast-water.html
[76] EMSA. 2021. Ballast Water Overview. http://www.emsa.europa.eu/we-do/sustainability/environment/ballast-water.html

and recycling of solid waste. Of the major cruise operators, Carnival Corporation & PLC self-reported recycling 27.6% of hazardous and non-hazardous waste in 2019[77], and Royal Caribbean[78] reduced waste-to-landfill by 85% between 2007 to 2020.

5.2.3 Other

Hull Biofouling

All marine vessels experience biofouling – **the accumulation of microorganisms, plants, algae or small animals on the ship's hull**[79]. Hull biofouling may contain invasive alien species (IAS) which travel on the ship's hull to new host environments where they reproduce and displace local marine life and threaten the economic stability of local communities that depend on coastal and marine environments. Biofouling also causes hydrodynamic friction and drag, so the vessel needs more fuel and therefore emits more[80].

Anti-fouling coatings or paint on the hull can be effective in combating the impacts of biofouling – the extra speed and fuel savings attainable from anti-fouling paints is notable, but anti-fouling paints can contain toxic biocides which are a threat to water quality and marine life.

In general, there is little cruise-industry specific data on this issue, and the extent to which the cruise tourism industry directly contributes to the spread of IAS from biofouling or the discharge of contaminants from anti-fouling measures cannot be stated with certainty. However, as a broad indication, cruise ships are estimated to have released the second-lowest quantity of copper and zinc compounds from anti-fouling paints in 2019[81], suggesting this issue is far greater for the majority of other marine vessels.

[77] Carnival Corporation PLC. 2021. Sustainable from ship to shore. 2020 Sustainability Report. https://carnival-sustainability-2021.nyc3.digitaloceanspaces.com/assets/content/pdf/2020-Sustainability-Report_Carnival-Corporation-plc.pdf
[78] Royal Caribbean Group. 2019. Sustainability Report. https://sustainability.rclcorporate.com/reporting/
[79] Uzun, Dogancan; Ozyurt, Refik; Demirel, Yigit Kemal; Turan, Osman. 2020. "Does the barnacle settlement pattern affect ship resistance and powering?". Applied Ocean Research. 95: 102020. doi:10.1016/j.apor.2019.102020. ISSN 0141-1187
[80] Uzun, Dogancan; Ozyurt, Refik; Demirel, Yigit Kemal; Turan, Osman. 2020. "Does the barnacle settlement pattern affect ship resistance and powering?". Applied Ocean Research. 95: 102020. doi:10.1016/j.apor.2019.102020. ISSN 0141-1187
[81] STEAM, 2021, 'Ship Traffic Emission Assessment Model', Finnish Meteorological Institute. https://en.ilmatieteenlaitos.fi

Collisions/physical disturbances with marine life

To date, most scientific publications on collisions with marine life have focused on the collisions between large vessels and large whales. However, a 2020 academic review found that **at least 75 marine species are affected**, including smaller whales, dolphins, porpoises, dugongs, manatees, whale sharks, sharks, seals, sea otters, sea turtles, penguins, and fish[82]. The species most vulnerable are marine mammals and sea turtles due to their size, their need to surface to breathe, and their migration routes, which overlap with shipping and cruising lanes.[83]

The consequences are mostly direct injury, impairment or death to marine animals, and occasionally vessel damage and injury to vessel crew. Collisions may occur because the ship's crew has not been able to spot nearby whales or because ships create 'acoustic disturbance' for marine animals. This may inhibit animals' ability to swim away from approaching ships. Given the growth in the number and size of cruise ships worldwide, collisions with marine life have the potential to be a growing problem if no mitigation efforts are deployed.

Several major cruise lines have adopted mitigation measures. These can include[84]: re-routing; travelling at a lower speed; better marine life detection from onboard the vessel; deterrent devices; propeller guards; and technological data and information systems (mandatory ship reporting; early warning systems; passive acoustic buoy systems).

[82] Schoeman, R.P., Patterson-Abrolat, C. and Plön, S., 2020. A global review of vessel collisions with marine animals. Frontiers in Marine Science, 7, p.292.
[83] EMSA. 2021. European Maritime Transport. Environmental Report 2021. https://www.eea.europa.eu/publications/maritime-transport
[84] Schoeman, R.P., Patterson-Abrolat, C. and Plön, S., 2020. A global review of vessel collisions with marine animals. Frontiers in Marine Science, 7, p.292.

Dredging (port development)

The construction and operation of new port and terminal facilities, or the expansion of existing facilities, typically involves dredging the local seabed and altering coastlines, with associated **impacts on terrestrial and aquatic habitats and biodiversity** (such as habitat fragmentation and the modification of hydrological processes), **as well as water quality and noise** (which adversely affects aquatic habitats and the health and behaviours of aquatic life).[85] Seabed dredging can result in rising water turbidity due to the suspension of sediments, presenting a major threat to local seagrass meadows and coral reefs.

The impact can be mitigated by Dredging Management Plans, incorporating a project risk assessment[86]. This can ensure that excavation and dredging methods are selected to minimise the suspension of sediments, minimise destruction of benthic habitat, increase the accuracy of the operations and maintain the density of the dredged materials (especially if the dredge area includes contaminated materials), and ensure dredged materials are reused or disposed of responsibly.

Noise

Noise pollution can take the form of **underwater noise or from port construction and activities**. Underwater noise from shipping is increasingly recognised as a significant and pervasive pollutant, affecting marine ecosystems on a global scale.

The main sources of underwater noise from cruise ships are the propeller, machinery (i.e. main and auxiliary engines) and the movement of the hull through the water.[87] This can create 'acoustic disturbance' for marine animals, which may inhibit whales' ability to swim away from approaching ships, thus resulting in vessel-marine life collisions as discussed above. Long-term exposure to intensive underwater noise results in the modification of behaviour and habitat use by some fish and mammal species.[88]

Noise from port construction and operation can also be harmful for marine life and habitats in local coastal regions, as well as to humans living and working in port areas, who are also affected by the noise from the associated road, rail and ship traffic and industry.[89] Health problems associated with noise include stress, cardiovascular

[85] Caric, H., Jakl, Z., Laurent, C., Mackelworth, P., Noon, V., Petit, S., Piante, C., Randone, M., 2019. Safeguarding Marine Protected Areas in the Growing Mediterranean Blue Economy. Recommendations for the Cruise Industry. PHAROS4MPAs project. https://doi.org/10.2495/DNE-V14-N4-264-274
[86] World Bank. 2017. Environmental, Health, and Safety Guidelines for Ports, Harbors, and Terminals. https://www.ifc.org/wps/wcm/connect/ddfac751-6220-48e1-9f1b-465654445c18/20170201-FINAL_EHS+Guidelines+for+Ports+Harbors+and+Terminals.pdf?MOD=AJPERES&CVID=lD.CzO9
[87] EMSA. 2021. European Maritime Transport. Environmental Report 2021. https://www.eea.europa.eu/publications/maritime-transport
[88] Williams, R., et al., 2015, 'Impacts of anthropogenic noise on marine life', Ocean & Coastal Management 115, pp. 17-24.
[89] Di Bella, A., 2014. Evaluation methods of external airborne noise emissions of moored cruise ships: an overview. In: 21st International Congress on Sound and Vibration 13-17 July.

disease and hearing loss. Noise is considered an important part of the human rights jurisprudence of the European Convention on Human Rights[90].

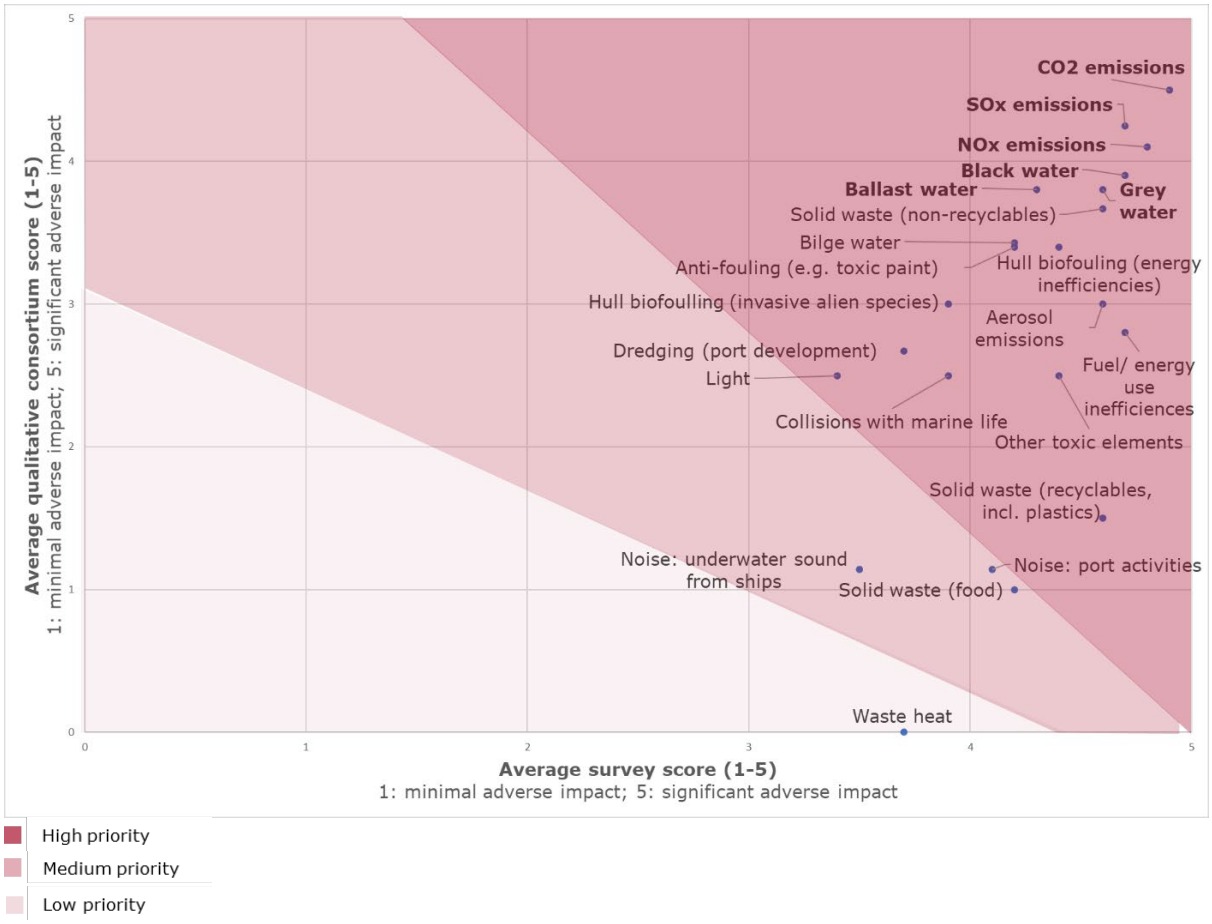
ESPO has identified six key steps in a Good Practice Guide on Port Area Noise Mapping and Management[91], i.e. taking into consideration the geographical situation and future developments, inventory of noise sources, noise modelling, noise mapping and action planning. These lead to the final step of ongoing noise management. The Port of Tallinn has been highlighted by ESPO as having effectively conducted a Port Area Noise Management Assessment.

5.3 Identifying priorities

No environmental challenge should, of course, be ignored, but there is a case for giving some a higher priority than others. To help the industry identify where its priorities should lie, this study carried out a materiality assessment of the challenges based on scores attributed to the different challenges by the study consortium's experts and a survey of external experts (Figure 23). (A matching exercise of identifying solutions and their materiality is in the next chapter.)

[90] ESPO. 2021. ESPO Green Guide 2020. https://www.espo.be/media/espopublications/espo_green%20guide_october%202012_final.pdf
[91] ESPO. 2021. Good Practice Guide on Port Noise Mapping and Management. https://www.espo.be/media/espopublications/good_practice_guide.pdf

Figure 23 Integrated materiality assessment of environmental challenges



Source: Deloitte/Ramboll analysis

Based on this assessment, **the challenges which need to be regarded as a high priority are:**

- **Emissions to the air – CO2 emissions, SOx emissions, NOx emissions and to a lesser extent aerosol emissions (particulate matter);**
- **Waste water – black water, ballast water, grey water** and to a lesser extent bilge water;
- **Other waste - in particular non-recyclable waste, notably plastics; anti-fouling systems and products** (e.g. toxic paint or paints containing microplastics)

Other high priority challenges, but around which there was less consensus, include hull biofouling (invasive alien species – considered alongside ballast water discharge); 'other' toxic elements, collisions/physical disturbances with marine life, light, dredging, waste at sea, waste heat and recyclable solid waste

Medium-priority challenges are noise in port and underwater noise, and solid food waste.

The only **low priority challenge** is waste heat.

Box 1 Upstream and downstream challenges

The materiality assessment above focused on emissions to air and water. However, there are **upstream and downstream challenges** not considered in the materiality assessment that need to be borne in mind when looking at the overall picture:

Upstream

Ship construction

Cruise ships **require large quantities of materials (with associated embedded carbon and other potentially hazardous substances** such as heavy metals and hydrocarbons) and energy-intensive manufacturing processes, all of which lead to air pollutants and other discharges into the environment.

Downstream

Ship disposal

Every year, ships reaching their end-of-life are dismantled to recycle the steel and other key components. **Old ships contain many hazardous materials, including polychlorinated biphenyls (PCBs), tributyl tin and large quantities of oils and oil sludge**, all of which can be discharged when the ship is recycled. As awareness of this has risen, so has pressure to invest in the sustainability of ship dismantling, particularly for passenger ships which contain a wide range of materials, including composites which are very difficult to separate and recycle. Several major cruise lines do not scrap on beaches. All shipping is bound by international regulation: the Hong Kong International Convention for the Safe and Environmental Sound Recycling of Ships (HKC)[94] and in the case of the EU, the EU Ship Recycling Regulation (1257/2013),[95] which is based on the HKC.

Passengers at destination (overtourism)

A 2020 report investigating the carbon footprint of tourism in Barcelona found that while "cruise day-trippers" contributed to only 0.9% of arrival and departure transport GHG emissions – attributable to their small numbers – they had the **largest unitary emissions among the types within the day tripper category** (66.1 kg CO_2 eq/cruise day-tripper).[96]

[92] International Maritime Organizational. 2009. The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships. https://www.imo.org/en/About/Conventions/Pages/The-Hong-Kong-International-Convention-for-the-Safe-and-Environmentally-Sound-Recycling-of-Ships.aspx#:~:text=Recycling%20of%20Ships-,The%20Hong%20Kong%20International%20Convention%20for%20the,Environmentally%20Sound%20Recycling%20of%20Ships&text=The%20Hong%20Kong%20Convention)%20is,safety%20or%20to%20the%20environment)

[93] European Commission. 2013. Regulation (EU) No 1257/2013 of the European Parliament and of the Council of 20 November 2013 on ship recycling and amending Regulation (EC) No 1013/2006 and Directive 2009/16/EC. (https://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:330:0001:0020:EN:PDF#:~:text=The%20purpose%20of%20this%20Regulation%20is%20to%20enhance%20safety%2C%20the,subject%20to%20environmentally%20sound%20management)

[94] https://www.imo.org/en/About/Conventions/Pages/The-Hong-Kong-International-Convention-for-the-Safe-and-Environmentally-Sound-Recycling-of-Ships.aspx

[95] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013R1257

[96] https://ajuntament.barcelona.cat/turisme/sites/default/files/barcelona_tourism_for_2020.pdf

5.4 Findings

There are so many environmental challenges to cruise tourism that the principal challenge is knowing where to start. This chapter has nevertheless identified a number of priorities, of which the highest are to address emissions, particularly CO2, SOx and NOx from the fuel burned for propulsion, as well as waste water, particularly black water, ballast water and grey water, and certain forms of waste. The next chapter looks at potential solutions by using alternative fuels and alternative forms of power generation, different systems, changes to ship design, shoreside solutions and voyage optimisation.

CHAPTER 6: CRUISE TOURISM – POTENTIAL ENVIRONMENTAL SOLUTIONS

6.1 Introduction

In this section we consider what technology can already offer by way of 'green' solutions, either in the short or medium term, and consider their strengths and weaknesses, broken down by solutions to fuel use (alternative fuels and alternative power generation), systems, ship design, shoreside solutions and voyage optimisation. Figure 24 provides an illustrative overview.[97] The chapter also looks at which might be the most promising transition and no-regrets solutions as not-yet-ripe technologies mature. It concludes with a sustainability roadmap.

Figure 24 Schematic overview of key green technological solutions

Source: Ship image obtained from: *https://www.cadnav.com/3d-models/model-51086.html*

6.2 Where the solutions may lie

6.2.1 Fuel use

Cutting emissions from propulsion has the potential to make a major contribution to reducing the cruise industry's carbon footprint and its other emissions. **Even switching to fossil fuels other than HFO and MGO, such as liquefied natural gas and methanol, could mitigate emissions to some extent**. There is also potential to use renewables in combination with fossil fuels. Alternative fuels offer the potential for very low, and even zero[98], greenhouse gas (GHG) emissions during their production,

[97] Low Sulphur Marine Gas, Oil and Water-in-fuel emulsion (e.g. Multiphase Superfine Atomised Residue (MSAR)) and nuclear power are not considered here as they do not appear to have potential for widespread use though they are considered in some literature.

[98] These so called zero-carbon bunker fuels encompass fuels which are "effectively zero" (that is, where the fuel is produced from zero-carbon electricity, for instance, hydrogen produced from solar or wind power), or

distribution and use. However, many of the alternative fuels are regarded as uneconomic or have inhibiting physio-chemical characteristics (e.g. low flashpoints and higher volatilities) in existing powertrains. We look below at the potential for different fossil fuels from those in use today, with the possible adjunct of renewables and then at alternative fuels with a low carbon footprint.

Alternatives to HFO and MGO

Liquefied natural gas

LNG is presently the preferred alternative fuel being implemented by cruise ships.[99] According to DNV Alternative Fuels Insights statistics[100], there are nine LNG-operated cruise ships in operation globally, with between 26 ships committed to relying on LNG for primary propulsion on order or under construction. Availability of suitable port infrastructure for bunkering and delivery to the ship are prerequisites for LNG use and only some ports so far have it (Figure 25). Rotterdam (Box 2) is a major exception. However, Directive 2014/94/EU on the deployment of alternative fuels infrastructure (AFID)[101] requires ports to provide LNG infrastructure in Trans-European Network (TEN-T) core network. FuelEU Maritime[102] is intended to ensure that ships actually use the infrastructure available in ports.

Figure 25 LNG facilities in the EEA

"net-zero" (that is, where the production of the fuel removes a quantity of carbon dioxide from the atmosphere equivalent to that emitted during combustion, such as with biofuels).

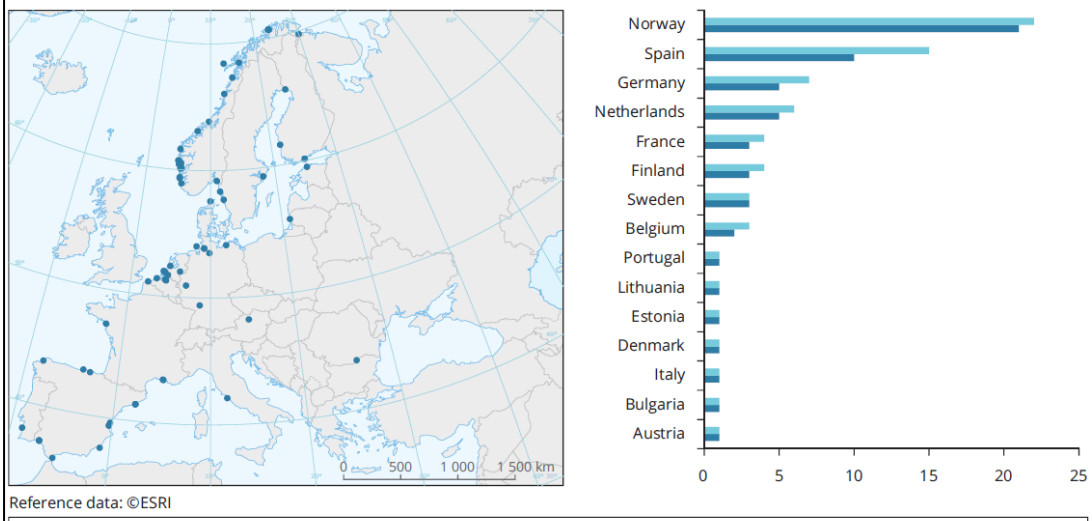
[99] Oxford Economics. 2020. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/research-updates/research/clia-environmental-study-report.ashx

[100] DNV. 2022. Alternative Fuels Insights. Statistics. https://afi.dnvgl.com/Statistics?repId=0

[101] European Commission. 2021. Directive 2014/94/EU of the European Parliament and the Council of 22 October 2014 on the deployment of alternative fuels infrastructure. https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32014L0094

[102] European Commission. 2021. Regulation of the European Parliament and of the council on the use of reneable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC. https://ec.europa.eu/info/sites/default/files/fueleu_maritime_-_green_european_maritime_space.pdf

Figure 5.15 Number of ports and LNG facilities in the European Economic Area in 2020



Source: EAFO (2020b).

Source: European Maritime Transport Environmental Report (2021)

Box 2 Good practice in Rotterdam

Rotterdam is considered a European leader in the management of LNG as a fuel. The port is taking a leading role in adapting regulation and creating the necessary infrastructure. In 2014, as a result of a change in the Management By-laws of the Port of Rotterdam, Rotterdam became the first port where ship-to-ship LNG bunkering of seagoing vessels was officially allowed. Truck-to-ship bunkering of inland vessels was already possible before that.

However, there are doubts about the capability of LNG to contribute meaningfully to lifecycle GHG reductions because of uncertainties about supply chain characteristics, ship and engine specifications. Moreover, moving to LNG presupposes a major investment in port facilities, although it is possible that these could later be reused for low- and zero-carbon future fuels e.g. liquefied biomethane and green liquefied synthetic methane. This nevertheless casts doubt on LNG's usefulness as a transitional fuel as **there is an argument that it would be better in terms of the overall investment required to move directly to alternative fuels and convert infrastructure in a single-stage process** rather than converting first to LNG and then to alternative fuels. There is also a risk of technology lock-in which would be incompatible with meeting climate targets.

A 2021 World Bank Report[103] found that there are no unambiguous drivers of large-scale uptake of LNG, even in the short term. There might be circumstances where the need to achieve short-term air quality benefits, for example overrode other considerations, but this would probably require regulatory intervention.

[103] Englert, Dominik; Losos, Andrew; Raucci, Carlo; Smith, Tristan. 2021. Volume 2: The Role of LNG in the Transition Toward Low- and Zero-Carbon Shipping. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/ handle/10986/35437 License: CC BY 3.0 IGO.

However, LNG is widely considered in the literature, there are examples of it being used and EU legislation encourages its use as a transitional solution.

Auxiliary wind power

Wind-assisted propulsion is a potential auxiliary or supporting method for reducing fossil fuel consumption. Using wind reduces emissions, draws on an unlimited energy source, is compatible with all fuels and has low operational costs.

Downsides included the difficulty of accurately measuring and quantifying the emissions reduction contribution, intermittent wind supply implies and the need for specialists for maintenance and repair work.[104] **The use of wind turbines** (used to supplement operational energy requirements rather than for propulsion) **can introduce additional drag** and lead to a net increase in fuel consumption as the energy produced does not compensate for the additional fuel needed to compensate for drag.

Moreover, while cruise lines are generally open to supporting wind power, they must reconcile this with the constraints from their usage of outdoor areas. Space on cruise ships is at a premium, and having uninhibited passenger viewing points and on-deck experiences are success factors. Nevertheless, according to the International Windship Association[105], three cruise and ferry ships were installed with wind propulsion technology in 2021, and the number is expected to rise over the next few years.

Solar

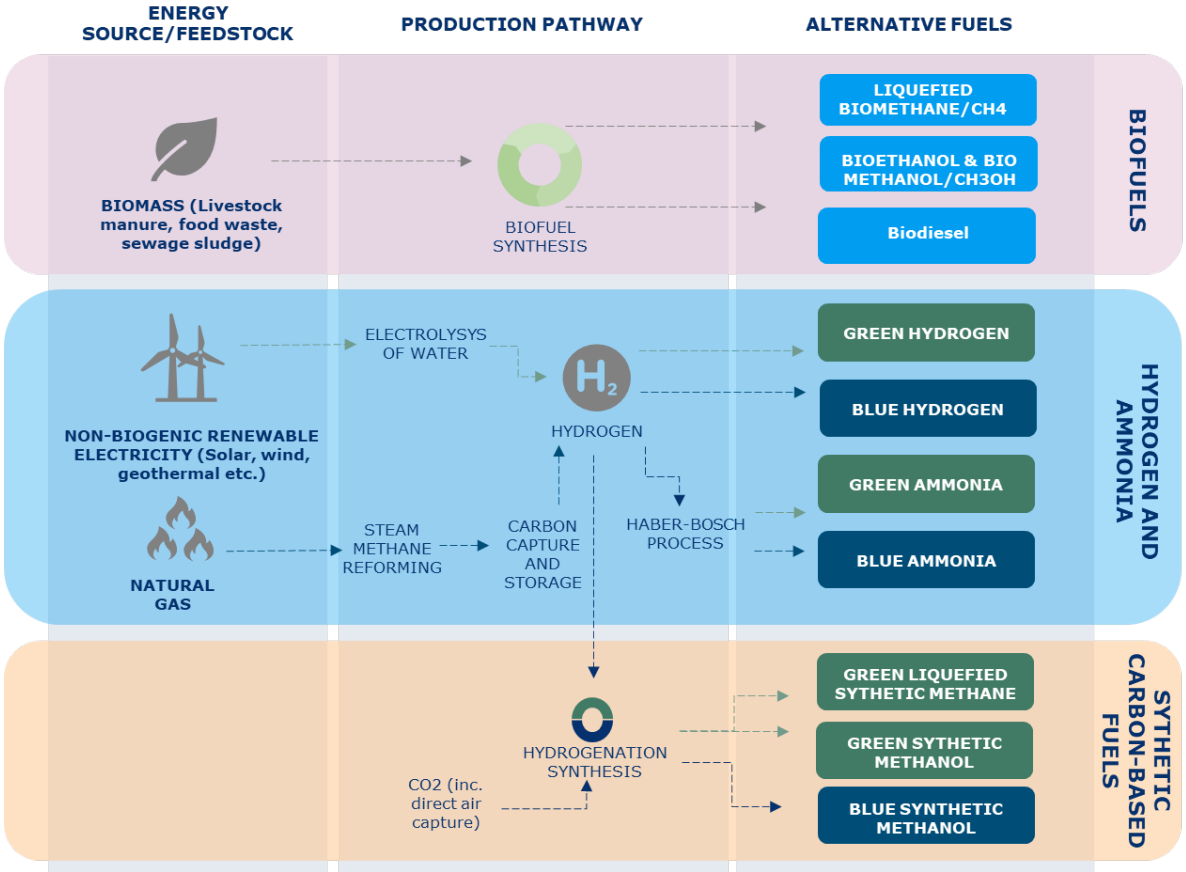
Much like wind power, renewable solar power can be used to supplement energy supplies and, in turn, reduce GHG intensity and associated emissions. However, solar power on a cruise ship is **unlikely to yield adequate levels of baseload power** to contribute meaningfully to the ship's propulsion (particularly given limited space on board ships). It may hold the potential to supplement energy supplies for smaller non-propulsion onboard energy systems. Solar panels are also likely to take up deck space and this is at a premium on cruise ships. Thus, solar power has positive but minor potential.

Alternative fuels

Alternative fuels fall into three broad categories illustrated in Figure 26. Biofuels, Hydrogen and Ammonia, and Synthetic Carbon-Based Fuels. In the absolute they can significantly reduce or even eliminate greenhouse gas and other emissions. However, **they are only truly green (as is also the case of wind and solar power) if their upstream production processes are also green**. This should be taken into account in each case.

[104] European Commission. 2021. Proposal for a regulation on the European Parliament and of the council on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC. https://ec.europa.eu/info/sites/default/files/fueleu_maritime_-_green_european_maritime_space.pdf
[105] Allwright, Gavin. 2021. Decade of Wind Propulsion 2021-2030. Presentation delivered as a webinar on 5 July 2021: How to Decarbonise Shipping by 2050.

Figure 26 The production processes of alternative fuels



Source: adapted from https://openknowledge.worldbank.org/handle/10986/35435[106]

Biofuels

Biofuels is a collective term that describes fuels derived from feedstock resources and residues (such as oil and sugar crops, forests and algae) that are converted into liquid or gaseous fuels. Biodiesel is most suitable for replacing MGO (although it is more commonly used as a fuel blend, being poured directly (a drop-in) into blended fuels), liquefied biogas (LBG) for LNG, and straight vegetable oil (SVO) to replace conventional fossil fuels).

Biomethanol and liquefied biomethane have potential uses as low-carbon bunker fuel. They can either be burned in an internal combustion engine or chemically converted into electricity using a reformer and a fuel cell. If converted into electricity, the reformer creates a hydrogen stream that is used in the fuel cell to create electricity and a waste CO_2 stream. The resulting electricity can then be used to power an electric motor, thus driving the ship's propeller.[107] Using biofuels significantly reduces GHG emissions.

[106] Englert, Dominik; Losos, Andrew; Raucci, Carlo; Smith, Tristan. 2021. Volume 1: The Potential of Zero-Carbon Bunker Fuels in Developing Countries. World Bank, Washington, DC. World Bank.
[107] Englert, Dominik; Losos, Andrew; Raucci, Carlo; Smith, Tristan. 2021. Volume 2: The Role of LNG in the Transition Toward Low- and Zero-Carbon Shipping. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/ handle/10986/35437 License: CC BY 3.0 IGO.

Looking at the maritime industry as a whole, a forward-looking baseline scenario showing developments under current trends and policies projects a limited uptake of sustainable biofuels in international maritime by 2050 (0.1% in 2030 and 1.3% in 2050).[108]

There is little available statistical evidence to indicate the uptake of biofuels by the cruise tourism industry specifically. However, there are isolated examples – The AIDAprima was refuelled with sustainable biofuel from GoodFuels in 2022.[109]

Methanol

Methanol, with the chemical structure CH_3OH, has the lowest carbon content and highest hydrogen content of any liquid fuel. It can be used in existing internal combustion engines, subject to some modifications, and potentially in fuel cell applications.

Methanol can be produced from many different feedstocks, such as natural gas or coal, or from renewable resources such as biomass (e.g. farmed wood, wood waste) or captured CO_2 and hydrogen – the chemical composition remains the same, regardless of the source. If produced from direct air capture and hydrolysed using renewable electricity, methanol can be carbon neutral. **Methanol also has the potential to provide a very good stable and safe hydrogen carrier, so it can be used to produce hydrogen and can be directly used in fuel cells.**

Methanol is relatively easy to store and handle, and is a mature technology that is already being produced on a commercial scale from natural gas. Depending on the fuel source used, methanol has the potential to save significant emissions of pollutants as it is a relatively pure substance that does not contain sulphur and produces only low PM emissions during combustion.

According to DNV's Alternative Fuels Insights[110], there are approximately 29 methanol bunkering facilities in operation in Europe today. There is limited evidence available that indicates the uptake of methanol specifically by the cruise tourism industry.

Ammonia

Ammonia (NH_3) is a compound of nitrogen and hydrogen. As a hydrogen carrier, it can be used in certain fuel cells or as a fuel for direct combustion in internal combustion engines. In combination with internal combustion engines, its expected performance is similar to that of conventional fuels in terms of power density and load response. However, its **toxicity and more stringent storage and handling requirements mean that ammonia engines are still in the development stage.**[111] This safety risk is particularly telling for passenger ships like cruise liners.

Like methanol, ammonia can be synthesised from fossil fuels or biomass using conventional or renewable energy. This suggests ammonia holds significant potential as a low-carbon, future fuel candidate assuming it can be developed at scale and its safety and handling risks are mitigated. Moreover, as argued by NABU (Naturschutzbund Deutschland)[112], its important role in the decarbonisation of other industries of the economy suggests that investments in ammonia infrastructure would not result in a

[108] European Commission. 2021. Proposal for a regulation on the European Parliament and of the council on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC. https://ec.europa.eu/info/sites/default/files/fueleu_maritime_-_green_european_maritime_space.pdf
[109] https://www.carnivalcorporation.com/news-releases/news-release-details/aida-cruises-starts-use-biofuels
[110] DNV GL. 2021. Alternative Fuels Insights: Map. https://afi.dnvgl.com/Map
[111] EMSA. 2021. European Maritime Transport Environmental Report (EMTER) 2021. https://www.eea.europa.eu/publications/maritime-transport
[112] Cames, M., Wissner, N., Sutter, J. 2021. Ammonia as a marine fuel. Report for NABU. https://en.nabu.de/imperia/md/content/nabude/verkehr/210622-nabu-study-ammonia-marine-fuel.pdf

stranded asset even if ammonia were not widely used as a fuel in shipping, making ammonia a low-regret decision.

According to DNV's Alternative Fuels Insights[113], there are approximately 53 ammonia bunkering facilities in operation in Europe today.

There is little available evidence of the extent to which ammonia is used specifically in the cruise tourism industry.

Hydrogen

Hydrogen (H2) is a colourless, odourless and non-toxic gas that is an energy carrier and a widely used chemical commodity. As an alternative fuel in shipping, it can be stored either in liquid form, as compressed gas, or chemically bound. Hydrogen is a critical component of the future fuel landscape given that all alternative fuels (except biofuels) are based on hydrogen.

Hydrogen can be used in two ways: in internal combustion engines (as a replacement in the combustion process or as a dual fuel mixture with conventional fuels); and in fuel cells. In an internal combustion engine, hydrogen can be burned in the same way as traditional fuel oils or LNG. However, this combustion will produce NOx as one part of the exhaust gas stream. In fuel cells, hydrogen is combined with oxygen in a process that is the reverse of electrolysis, with both heat and water as by-products of electricity generation. No air pollutant emissions are formed during this process, implying that it will be its well-to-tank emissions alone that will make up its total well-to-wake emissions.[114]

"Green" hydrogen is hydrogen produced from the electrolysis of water – the process of running an electric current through water, thereby splitting water molecules into oxygen and H_2 – using renewable electricity. Using renewable energy makes electrolysis almost carbon-free. However, the process is energy-intensive, rendering the production of green hydrogen inefficient and costly.[115] "Blue" hydrogen is hydrogen produced from the steam methane reforming of natural gas combined with a carbon capture and storage (CCS) plant. If CCS is not used, this process results in "grey hydrogen". ("Blue" ammonia is produced by combining "blue" hydrogen with nitrogen from the atmosphere using the Haber-Bosch process.[116])

There is little available evidence of the extent to which hydrogen is used specifically in the cruise tourism industry. Isolated examples of its increasing use can be found – three MSC Cruises ships include a containment system for liquid hydrogen for hotel operations in port, and two Viking ships will be partly powered by hydrogen.[117]

[113] DNV GL. 2021. Alternative Fuels Insights: Map. https://afi.dnvgl.com/Map
[114] EMSA. 2021. European Maritime Transport Environmental Report (EMTER) 2021. https://www.eea.europa.eu/publications/maritime-transport
[115] EMSA. 2021. European Maritime Transport Environmental Report (EMTER) 2021. https://www.eea.europa.eu/publications/maritime-transport
[116] Englert, Dominik; Losos, Andrew; Raucci, Carlo; Smith, Tristan. 2021. Volume 1: The Potential of Zero-Carbon Bunker Fuels in Developing Countries. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/35435 License: CC BY 3.0 IGO
[117] PRG expert comment. Provided August 31st, 2022.

Comparative fuel analysis

Table 6 below assesses the evidence of alternative fuels presented above against a range of parameters identified in the literature within a "Red-Amber-Green" (RAG) matrix. Red denotes poor performance, amber a mid-level score, and green a good score. This assessment is high-level and broad. The precise performance of each fuel against each criterion is strongly determined by a multitude of (often location-specific) factors.

Table 6 Comparative fuel analysis

Category		Fossil fuel (without CCS)				Bio-fuels	Renewable energy sources			
Energy source		HFO + scrubber	Low sulphur fuels	LNG	Methanol	Bioethanol, biomethanol, liquefied biomethane	Ammonia	Hydrogen (green and blue)	Solar	Wind
Applicability and scalability	Energy density									
	Technological maturity									
	Flammability and toxicity									
	Bunkering availability									
	Commercial readiness									
Economics	Price									
	Energy costs (Opex)									
	Energy costs (Capex)									
Environment	GHG emissions - well-to-wake									
	Local emissions: SOx, Nox and PM									

Legend:

n.a.	Worst				Best

Source: Adapted from: DNV GL. 2019. Assessment of Selected Alternative Fuels and Technologies[118]

[118] https://www.dnv.com/maritime/publications/alternative-fuel-assessment-download.html; Englert, Dominik; Losos, Andrew; Raucci, Carlo; Smith, Tristan. 2021. Volume 1: The Potential of Zero-Carbon Bunker Fuels in Developing Countries. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/35435 License: CC BY 3.0 IGO; Additional insights from evidence base established earlier in this report.

The comparative fuel analysis suggests specific takeaways:

- **LNG arguably has a transitional role in the future fuels landscape**, albeit a limited one given that there are doubts by some over the capability of LNG to contribute meaningfully to whole lifecycle GHG reductions. Currently it remains the most readily available alternative to conventional fossil fuels.

- **Green ammonia, green hydrogen and green methanol have the most favourable balance based on the parameters considered.** In addition to their positive emissions abatement potential, they have the advantage of being scalable and can be used in a modified internal combustion engine. Given the inherent uncertainty about the future fuels landscape, this versatility provides an important strategic advantage. However, these alternative fuels do have limitations, and significant development of the technologies and the supporting infrastructure is required. Hydrogen is more expensive to store and handle than ammonia, and hydrogen's volumetric requirements are a particular challenge. Ammonia is limited by its toxicity, but if ammonia can be effectively and safely produced and managed, it may emerge as a prioritised green technological solution. Methanol has the lowest carbon content and highest hydrogen content of any liquid fuel, but it is constrained by the availability of sustainable feedstock, and there is limited evidence of its use in the cruise industry specifically.

- There is growing interest in the role for synthetic e-fuels produced using green hydrogen. **E-methanol is the most market-ready marine e-fuel and could become increasingly competitive within the next two decades**, using biomass-derived CO2.

- **Biofuels such as biomethanol will likely play a relatively minor (transitional) role in cruise tourism's future energy mix**. Their use will be constrained largely by the (non)-availability of sustainable feedstock and by high demand from other industries with a more restricted choice of sustainable low and zero GHG fuels, e.g. aviation.

- **Wind power assistance and solar** have positive emissions abatement potential, but their **inability to provide sufficient baseload power** – in addition to space and visual limitations on board – suggests they are better suited as supplementary power sources for onboard, non-propulsion systems.

Nevertheless, the fuel transition in shipping has started and is gaining momentum. While not specific to cruise tourism (although it is still an indication), the 2021 DNV Maritime Forecast[119] estimated the following changes in fuel use by new ships on order from 2019 to 2021:

- Hydrogen: 0.04% to 0.06%
- Ammonia: 0.02% (in 2021)
- LNG: 2.73% to 6.10%
- Methanol: 0.08% to 0.30%
- Battery: 3.07% to 3.85%.

The limitations for each alternative fuel investigated suggest that **any major uptake of alternative fuels will depend largely on R&D efforts, supporting infrastructure rollouts, regulation, and incentive schemes** to make them more competitive with

[119] DNV GL. 2021. Maritime Forecast to 2050. https://eto.dnv.com/2021/maritime-forecast-2050/about#:~:text=Offers%20shipowners%20practical%20advice%20and,demands%20from%20investors%20and%20institutions.

current fuels. Considering the uncertainty about the future fuels landscape, dual-fuel technology is emerging as the best hedging option. Increased coordination and cooperation between cruise shipowners and other relevant stakeholders in this context will also be pivotal.

6.2.2 Systems

Batteries

Batteries can store electrical energy for propulsion. They do not represent the source of power and are therefore not strictly speaking considered alternative fuels. Largely currently based on lithium-ion (Li-ion) chemistry, in the future other lithium- and non-lithium-based chemistries are expected to gain ground.[120] Cruise ships' batteries can be charged using either OPS or onboard electrical power generation, with the latter supplied by various options such as co-generation, micro-generation, waste heat recovery systems or solar PV (photovoltaic).

Batteries can either be used to create a hybrid ship (where batteries supplement other fuels) or an all-electric ship (where batteries act as the energy source for heavy-duty onboard operations, such as propulsion and providing energy to diverse auxiliary systems). Fully electric ships eliminate the tank-to-propeller emissions of CO_2, SOx, NOx and PM (and noise, depending on the propulsion system). In a hybrid ship, the emissions reduction will depend on the level of hybridisation.

The disadvantages of batteries on cruise ships include safety considerations and thermal runaway, as well as challenges to integrating batteries onboard, given their weight, volume and low energy density. This is likely to limit their use to hybrid operations in the short term. However, as battery technology improves alongside increasingly electrified power systems economy-wide (implying falling battery costs in line with the 'learning effect'), opportunities will emerge to optimise the efficiency, safety and control of battery power.

The low energy density of existing batteries suggests that all-electric ships are only viable for short-sea trips, but hybrid ships are becoming common. The European Alternative Fuels Observatory[121] estimates that of the marine vessels (non-cruise specific) with batteries, approximately 50% were hybrid and 22% were pure electric in 2022. For the cruise tourism industry specifically, a handful of cruise ships equipped with batteries are in operation, with 18 under construction.[122]

[120] EMSA. 2021. European Maritime Transport Environmental Report (EMTER) 2021. https://www.eea.europa.eu/publications/maritime-transport
[121] EAFO. 2021. Electric and hybrid seagoing vessels. https://alternative-fuels-observatory.ec.europa.eu/transport-mode/maritime-sea/vessels
[122] DNV GL. 2021. Alternative Fuels Insights: Statistics. https://afi.dnvgl.com/Statistics?repId=0

Box 3 Hybrid battery-powered cruise ships

In 2019, the first hybrid battery-powered cruise ship, the Roald Amundsen, set sail for the Arctic. Designed to take 500 passengers and operate in harsh climate waters, the cruise ship uses a hybrid system that runs mainly on MGO but can be switched to its battery pack for 1-hour long portions (under ideal conditions). The cruise operator, Hurtigruten, estimated that this battery pack would reduce CO_2 emissions by 20% through fuel savings, compared to operating on MGO alone.

Fuel cells

Fuel cells are an energy conversion system (and are therefore not considered an alternative fuel). They convert the chemical energy contained in the fuel into electrical and thermal energy through electrochemical oxidation before being consumed directly, or indirectly stored in batteries.[123] Fuel cells are primarily hydrogen carriers as they need a hydrogen-rich fuel for the chemical process. Apart from the use of pure hydrogen, chemical reactors (fuel reformers) are used to convert other fuels such as natural gas, methanol or diesel to hydrogen-rich fuel for the cells.

There is a clear environmental advantage to using fuel cells compared to fossil fuels in their potential to reduce CO_2 emissions, noise and vibration, and eliminate local emissions such as SOx, NOx and PM. Due to their high energy efficiency, a reduction of onboard CO_2 emissions by 30% is possible when using hydrocarbon-based fuels like natural gas or methanol, according to DNV GL.[124] Fuel cells powered by hydrogen generated from renewable energy can lead to near-zero emissions.

Fuel cells also face challenges, most notably with respect to safety. The most efficient fuel cells operate at temperatures in excess of 1 000º C and therefore require careful safety measures.[125] Moreover, existing fuel cells offer minimal energy capacity, rendering commercial use on large cruise ships unlikely without significant developments.[126] Overall, fuel cells are not yet cost-competitive, and their future deployment hinges on the availability of suitable fuels such as hydrogen.

There is little cruise-specific information, and the extent to which fuel cells have been deployed in the cruise tourism industry is unclear. However, Royal Caribbean Cruises Ltd. will develop the next generation of LNG-powered cruise ships with innovations that include an application of fuel cells for power generation.[127] Silversea Cruises' 'Project Evolution' vessels will be the first cruise ships to use fuel cells to provide 100% of their power while berthed in port, eliminating all onboard emissions.[128]

[123] EMSA. 2021. European Maritime Transport. Environmental Report 2021. https://www.eea.europa.eu/publications/maritime-transport
[124] DNV GL. 2019. Comparison of Alternative Marine Fuels. https://sea-lng.org/wp-content/uploads/2020/04/Alternative-Marine-Fuels-Study_final_report_25.09.19.pdf
[125] EMSA. 2021. European Maritime Transport Environmental Report (EMTER) 2021. https://www.eea.europa.eu/publications/maritime-transport
[126] Teleconference interview conducted 11/05/2021.
[127] Tronstad, T., et al., 2017, Study on the use of fuel cells in shipping, European Maritime Safety Agency (http://www.emsa.europa. eu/newsroom/latest-news/item/2921-emsa-study-on-the-use-of-fuel-cells-in-shipping.html#:~:text=The %20EMSA %20 Study %20on %20the %20use %20of %20Fuel,& %20 Safety %20aspects %20in %20generic %20ship %20 design %20applications).
[128] Gibson, R. 2021. New Silversea ships to use fuel cells, LNG and batteries. Cruise and Ferry Network. https://www.cruiseandferry.net/articles/new-silversea-ships-to-use-fuel-cells-lng-and-batteries

End-of-pipe technologies

Whatever the pace of transition to alternative fuel sources, it is still possible to mitigate air pollutant emissions with **the use of after-treatment systems that remove pollutants from the exhaust gases resulting from the combustion processes on board ships**. Several after-treatment technologies are available for cruise ships, such as diesel particulate filters and selective catalytic reduction systems. Exhaust gas cleaning systems (EGCSs), commonly referred to as scrubbers, are the most prominent, mature and widely used of these technologies – and therefore the focus here.

An EGCS is designed to clean the exhaust by washing out SOx matter and particles, and can be used as an alternative to cleaner fuels (in combination with traditional fossil fuels), or in combination with cleaner fuels, such as low-sulphur fuel. **Scrubbers can be broadly classified into wet and dry systems.** Wet systems use sea or freshwater to remove air pollutants and are mostly used onboard ships; dry systems are normally used in shoreside applications. **Wet systems feature far more prominently in the cruise tourism industry.**

Wet systems can be further be broken down into three categories depending on whether they are open-loop, closed-loop or hybrid (operating in either open or closed-loop mode). In open-loop EGCS, sea water is used to clean the exhaust gases from the ship's engines, and then discharged back into the sea (untreated or treated washwater). If untreated, this washwater can contain heavy metals and other toxic substances that can potentially reduce water quality and harm marine organisms.[129] Treating washwater before discharge is not mandatory and most open-loop scrubbers do not filter the washwater before dumping it overboard[130]. In closed-loop EGCSs, freshwater that is treated with an alkaline chemical such as sodium hydroxide for neutralisation is used for exhaust gas cleaning. The resulting discharge is then recirculated and stored for on-land disposal, with a small proportion being discharged as highly concentrated "bleed-off".[131] Depending on the system and the fuel used, SOx emissions can be reduced by 70-95%, and a portion of PM and NOx emissions can also be reduced[132] [133].

However, EGCS can also have adverse environmental impacts, most notably from the washwater discharge from open-loop systems. Concerns about the negative effects include acidification (change in pH values) and releases of heavy metals and polycyclic aromatic hydrocarbons (PAHs).[134] There is research suggesting that all scrubbers discharge washwater that is more acidic than the surrounding seawater and which contains polycyclic aromatic hydrocarbons (PAHs), PM, nitrates, and heavy metals including nickel, lead,

[129] EMSA. 2021. European Maritime Transport Environmental Report (EMTER) 2021. https://www.eea.europa.eu/publications/maritime-transport
[130] European Sustainable Shipping Forum. (2017). Questions for the ESSF sub-group on exhaust gas cleaning systems regarding waste from scrubbers. European Commission Directorate-General for Mobility and Transport. https://ec.europa.eu/ transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&id=29309&no=5
[131] Magnusson, K., Thor, P., & Granberg, M. 2018. Scrubbers: Closing the loop. Activity 3: Task 2 risk assessment of marine exhaust gas scrubber water (No. B 2319). IVL Swedish Environmental Research Institute. https://www.researchgate.net/profile/Maria_Granberg/ publication/333973881_Scrubbers_Closing_the_loop_Activity_3_Task_2_Risk_Assessment_ of_marine_exhaust_gas_scrubber_water/links/5d10af82299bf1547c79638a/Scrubbers-Closingthe-loop-Activity-3-Task-2-Risk-Assessment-of-marine-exhaust-gas-scrubber-water.pdf
[132] Gregory, D. and Confuorto, N., 2012, A practical guide to exhaust gas cleaning systems for the maritime industry Exhaust Gas Cleaning Systems Association, London.
[133] Oxford Economics. 2020. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/research-updates/research/clia-environmental-study-report.ashx
[134] Caric, H., Jakl, Z., Laurent, C., Mackelworth, P., Noon, V., Petit, S., Piante, C., Randone, M., 2019. Safeguarding Marine Protected Areas in the Growing Mediterranean Blue Economy. Recommendations for the Cruise Industry. PHAROS4MPAs project. https://doi.org/10.2495/DNE-V14-N4-264-274.

copper, and mercury. [135] The same research also found that, while scrubbers are effective at reducing air emissions of SO2, emissions of carbon dioxide, particulate matter and black carbon were higher with scrubbers compared with using MGO.

Additional criticism of the EGCS is that the IMO's global fuel sulphur limit creates a perverse incentive to continue to use heavier fuels (in combination with EGCS) instead of adopting cleaner fuels.[136] Indeed, under EU rules, only ships equipped with EGCS operating in closed mode are allowed to use fuel with a very high sulphur content. Thus, relying on scrubbers in combination with HFO may lengthen the transition to alternative fuels.

94% of new ships not relying on LNG as their primary fuel source will have EGCS installed[137], implying that the faster the transition to low-carbon alternative fuels, the fewer scrubbers will be used to mitigate emissions. However, the strong immediate need to reduce air pollutant emissions does not necessarily preclude EGCS from the basket of solutions available to cruise stakeholders.

Around one third of all cruise ships (34%) have scrubbers installed. They account for 4% of all ships with scrubbers, but 15% of discharge.[138] Cruise ships are the main contributor to scrubber discharges in port, accounting for 96% or more of discharges in seven of the ten ports with the highest total washwater discharges[139].

Advanced Wastewater Treatment Systems (AWTS)

There are two primary technologies that cruise ships can use to manage grey and black water discharges. First, ships can use traditional Marine Sanitation Devices (MSDs). However, these are rapidly being replaced by a second technology – advanced wastewater treatment systems (AWTS). These which provide **better screening, treatment, disinfection, and sludge processing**, and therefore form the focus of this section.

AWTS uses tertiary-level treatment, using bacteriological methods to break down contaminants in grey and black water.[140] Once the AWTS is fed with the waste, it then begins to use aerobic decomposition (with bacteria breaking down waste with oxygen). The resulting waste is then passed through to a settlement chamber where the dense material sinks to the bottom. The waste liquid is then passed back to the decomposition chamber until it is further broken down, before going to a final chamber for sterilisation (such as chlorination or UV treatment)[141]. The dense material residue can be incinerated or collected and sent ashore for processing. The treated effluent is often considered

[135] Comer, B., Georgeff, E., & Osipova, L. (2020). Air emissions and water pollution discharges from ships with scrubbers. Retrieved from the International Council on Clean Transportation website: https://theicct.org/publications/air-water-pollution-scrubbers-2020
[136] Marine Environment Protection Committee. 2019. Resolution MEPC.280(70). Effective date of implementation of the fuel oil standard in regulation 14.1.3 of MARPOL Annex VI. Retrieved from https://docs.imo.org
[137] Oxford Economics. 2021. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/clia-media/research/2021/economic-impact/clia-env-study---11-01-2021---final.ashx
[138] Comer, B., Georgeff, E., & Osipova, L. (2020). Air emissions and water pollution discharges from ships with scrubbers. Retrieved from the International Council on Clean Transportation website. https://theicct.org/publications/air-water-pollution-scrubbers-2020
[139] Comer, B., Georgeff, E., & Osipova, L. (2020). Air emissions and water pollution discharges from ships with scrubbers. Retrieved from the International Council on Clean Transportation website. https://theicct.org/publications/air-water-pollution-scrubbers-2020
[140] Oxford Economics. 2021. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/clia-media/research/2021/economic-impact/clia-env-study---11-01-2021---final.ashx
[141] Casual Navigation. 2019. What happens after you flush the toilet on a cruise ship? Youtube video. https://www.youtube.com/watch?app=desktop&v=5Z7bTmZVPTI

equivalent to effluent produced by the best shoreside treatment plants and may then be discharged at sea. [142]

Other measures as part of AWTS include the use of biological cleaners such as Bio WCSC, Bio Scale Zapper and Bio ETSC. [143] These products are biological toilet and urinal cleaners which use competitive exclusion (i.e. they break down bacteria and pathogens not by killing them, but by suppressing their growth) to prevent scale formation in wastewater pipes and pre-digest waste, which in turn reduces the load on treatment plants.

According to the CLIA[147], current global AWTS coverage is 74%. This is expected to increase since 100% of new capacity on order specifies installation of AWTS. The rapid implementation of AWTS suggests that any cost or infrastructure obstacles are not prohibitive.

Bilge Water Treatment Systems (BWTS)

Following an advanced treatment process similar to AWTS, **bilge water treatment systems (BWTS) use bioremediation (or the use of bacteria) to break down the hydrocarbons in the bilge water into less harmful by-products**. The BWTS may include an oily water separator, which filters the effluent to a lower oil content. Any remaining sludge residues (still considered hazardous) can be incinerated or transported in holding tanks to port reception facilities. In 2018, MSC Cruises**Error! Bookmark not defined.** r eported disposing of over 40 000 metric tonnes of bilge and oily water at port reception facilities.

According to Cruise Europe, there are approximately 34 ports with reception facilities for waste oils, although only 24 were open (fully or under certain restrictions) at the time of writing. Whether these port reception facilities can cater for cruise ships specifically is unclear.

There is little existing data that indicates the extent to which cruise ships use advanced BWTS.

Ballast water treatment

Ballast water can be treated using advanced treatment systems, including mechanical filtration, exposing the water to ultraviolet light and chemical treatment. Alternatively, ballast water can be held until it can be transferred to port reception facilities.

There is little existing data that indicates the extent to which cruise ships use advanced ballast water treatment systems.

[142] Oxford Economics. 2020. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/research-updates/research/clia-environmental-study-report.ashx
[143] Hepburn Bio Care Group. 2021. Hepburn Bio WCSC. https://www.hepburnbiocare.com/product/Wastewater/Hepburn-Bio-WCSC
[144] MSC Cruises. 2020. Charting our sustainable future: 2019 sustainability report. http://viewer.zmags.com/publication/ad7ec97d#/ad7ec97d/24
[145] Cruise Europe. 2021. Sustainability: map. https://www.cruiseeurope.com/sustainability/
[146] Cruise Europe. 2021. Sustainability: map. https://www.cruiseeurope.com/sustainability/
[147] Oxford Economics. 2020. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/research-updates/research/clia-environmental-study-report.ashx

Sustainable onboard waste management

The impact of solid waste – comprising non-recyclable materials, recyclables (such as plastics, glass and paper), food waste, as well as incineration remains (ash) – depends on how it is managed. Cruise operators manage their solid waste on board.

Historically, cruise operators have incinerated or pulped certain types of solid waste before discharging them overboard, but in recent years **many cruise operators have been taking further steps to transport this waste ashore for disposal or recycling**. Even more, major cruise operators are aiming for zero-landfill by using a variety of technological measures. For instance, **onboard hydro-processing and biodigester plants can be used to capture bioenergy from food waste** (thereby supplementing onboard energy supply for non-propulsion operations), and recyclables and non-recyclables are transported to waste-to-energy or recycling partner facilities ashore.

Box 4 Good practice in food waste management

Together with the environmental association Futouris and with the support of United Against Waste e.V., TUI Cruises launched a food waste reduction project on their cruise ships in 2016. The pilot project started with food waste measurement, after which a catalogue of management measures was formulated. Measures include (but are not limited to): changes in catering equipment (such as smaller buffet containers and displays); changes in processes (such as arrangement and quantities of food); and awareness-raising activities (such as communication with and marketing to passengers, and training for crew).

For many of the onboard technological solutions, such as biodigesters and bailers, space and installation costs may appear prohibitive. However, given the large amounts of solid waste generated by passengers and crew every day when the ship is in operation, the expected benefits over the lifetime of the ship can be substantial. Moreover, these onboard technological solutions may lead to cost savings when the additional bioenergy created is accounted for.

However, waste management needs to consider the entire lifecycle of production and onboard consumption. Indeed, waste not only occurs at the end of use, but it also arises from incorrect planning and is generated along all the individual process steps (purchase, preparation, presentation, consumption etc.) Using a waste hierarchy, the preferred (and most cost-saving) solution is to prevent waste from occurring in the first place.

Carnival Cruises self-reported achieving a 24% food waste reduction per person in 2021 and achieved its goal of reducing single-use plastic items by 50%.[148] Cruise operators such as Norwegian Cruise Lines, Carnival Cruises, RCL and MSC have pledged to eliminate single-use plastics.

[148] Carnival Corporation PLC. 2022. Carnival Corporation Releases. 2021 Sustainability Report. News Release. [online https://www.carnivalcorp.com/news-releases/news-release-details/carnival-corporation-releases-2021-sustainability-report

Box 5 The role of ports in solid waste management

Ports also play a key role in the industry's solid waste management performance, particularly for receiving ship waste that cannot be reused or recycled onboard as well as waste generated by the ports themselves. Port waste reception facilities that provide adequate capacity to receive port- and ship-generated wastes, including appropriately sized and located receptacles, and the capacity to deal with seasonal fluctuations, need to be developed.[149] Moreover, by deploying waste-to-energy facilities wherever possible, ports can improve the overall circularity of energy consumption and production onshore to capture environmental and economic benefits. There is also potential to work with local port communities by providing expired food which can still be used by vulnerable/homeless people in need.

Air lubrication systems

An air lubrication system represents an example of **a particularly innovative and promising green technological solution for its ability to reduce the resistance between the ship's hull and seawater using air bubbles**. Air bubbles are pumped underwater across the hull surface, which reduces the resistance and drag working on the ship's hull, thereby saving fuel and reducing air pollutant emissions. An air lubrication system can achieve a reduction of 5-35% in CO2 emissions, depending on the type of marine vessel ship and its hull design. [151]

The application of air lubrication systems on cruise ships is still in its infancy, and little data exists describing the uptake of this technology by the cruise tourism industry. Isolated examples of cruise operators installing air lubrication systems include Norwegian Cruise Line's 163 000 GT new build in 2017 (which used a Silverstream System resulting in net efficiency gains of more than 5% in draughts of 8m to 9m with speeds ranging from 10-25 knots), two AIDA Cruise vessels in 2016 and 2017 (which used the Mitsubishi Air Lubrication System), two Princess vessels, and several RCL vessels.[152]

6.2.3 Shoreside

Onshore power supply

Onshore power supply (OPS), also known as shore-side electricity (SEE), shore-to-ship power or cold ironing, is a green technological solution that allows cruise ships docked at berth to plug into shoreside power and receive electricity. An electrical cable is extended from the pier and plugged into the ship's receptacle, which allows the ship to shut down its engines while berthed without disruption to onboard systems.[153] OPS can also theoretically be used by hybrid ships to power their batteries for propulsion (although this is still far from being commercially and technically viable, given the large baseloads of electricity required for propulsion). Both the ship and port are required to install OPS capabilities. While a growing proportion of maritime ships are equipped with the potential

[149] World Bank. 2017. Environmental, Health, and safety guidelines for ports, harbours, and terminals. https://www.ifc.org/wps/wcm/connect/ddfac751-6220-48e1-9f1b-465654445c18/20170201-FINAL_EHS+Guidelines+for+Ports+Harbors+and+Terminals.pdf?MOD=AJPERES&CVID=lD.CzO9
[150] Futouris. 2021. Reduction of food waste on cruise ships: project report and implementation guide. https://www.futouris.org/en/projects/reduction-of-food-waste-on-cruise-ships/
[151] Marine insight. 2020. How air lubrication system for ships works? https://www.marineinsight.com/green-shipping/how-air-lubrication-system-for-ships-work/
[152] Wartsila. 2021. Wartsila encyclopaedia of marine and energy technology: air lubrication. https://www.wartsila.com/encyclopedia/term/air-lubrication
[153] EAFO. 2021. Port infrastructure: OPS Technology. https://www.eafo.eu/shipping-transport/port-infrastructure/ops/technology

for OPS, these typically involve low-voltage OPS for limited energy supply. Cruise ships require high-voltage OPS to power their operations.

Box 6 OPS in practice

Hamburg

Cruise Gate Hamburg, the terminal operator of the Port of Hamburg, has been at the forefront of OPS use in Europe. After first launching an OPS station pilot project in 2016, Hamburg's Altona cruise terminal now regularly supplies cruise ships. This results in emissions reduction in the wider port area. Despite only one of its three terminals having an operational shore power station, in 2018 this was estimated to have reduced CO2 emissions by over 650 tons.

Bergen

The onshore power supply facility in Bergen is currently Europe's largest, with a capacity of 50 MVA, covering and supplying both cruise ships and offshore/supply vessels. Given that Bergen is Norway's largest cruise port and the fourth largest in Europe, this OPS capability will offer significant local air emission reductions from the numerous ships that dock there.

Juneau

In 2001, Princess Cruises began using shore power in Juneau, USA, in partnership with the city and Alaska Electric Light and Power Co. This has led to a win-win situation for both Princess Cruises and the residents of the city, where harmful air emissions fell. Moreover, the set-up of this OPS system is such that every dollar spent by Princess Cruises on purchasing electrical energy in Juneau is credited to a cost of the power adjustment that is used to offset any diesel expenses (with extra funds going back to city residents and businesses in the form of rebates on electric bills). To date it is estimated that this has benefited the Juneau community by USD 8.5 million.

Because OPS allows cruise ship operators to turn off the ship engines while in port, this reduces local air pollution and the noise typically associated with burning fossil-based fuels. This approach is particularly valuable given that air quality around ports is often poor, and they tend to be noisy locations. The use of renewable energy-based OPS in the Port of Charleston reduced CO_2 emissions by an estimated 36%[154], while another study estimates that renewable energy-based OPS could reduce CO_2 emissions by over 800 000 tons[155] in Europe alone (although this study was based on the whole maritime fleet and not cruise-specific).

Various technical challenges and uncertainty about the demand for OPS have held up adoption. OPS facilities and associated infrastructure, such as the electricity cable from the main electricity or transmission grid and the frequency converters require a major investment.[156] **Cruise ships' high energy requirements from OPS make high demands on the capacity of the local electricity grid**, a particular challenge in smaller port cities with sparse electrical infrastructure and a high number of cruise calls.[157]

[154] Corbett, J. J., & Comer, B. 2013. Clearing the air: Would shoreside power reduce air pollution emissions from cruise ships calling on the Port of Charleston, SC? Pittsford, NY: Energy and Environmental Research Associates
[155] Winkel, R. et al., 2016. "Shore Side Electricity in Europe: Potential and environmental benefits." Energy Policy, 88: 584-593.
[156] COWI. 2020. Towards Sustainable Cruise Tourism in the Greater Baltic Sea Region. Report for the Ministry of Environment and Food of Denmark.
[157] Ibid.

Nevertheless, the CLIA has reported that 65 of its member ships are outfitted with OPS capability, with 109 ships to be built new or retrofitted in the coming year. This will result in 35% of current global capacity being fitted with OPS capacity.[158]

However, there are currently only 16 ports globally that provide shore power specifically to cruise ships, with three in Germany and two in Norway,[159] and roughly 46% providing high-voltage electricity[160]. High costs, and a lack of funding and tax incentives appear to be barriers to port investments in OPS.[161] Without a concomitant rise in OPS installations in ports, OPS capabilities on ships will stand idle.

Regulation may force the hand of the cruise lines and the ports. The EU is envisaging under the European Green Deal[162] that from 1 January 2030, a ship at berth in a port of call under the jurisdiction of a European Member State will be required to connect to an onshore power supply and use it for all energy needs while at berth. This requirement is also reflected in the proposed revision of the Alternative Fuels Infrastructure Directive (AFID)[163] under the Fit-for-55 package, which aims to speed up the deployment of refuelling/recharging infrastructure. This implies that both the ports visited, and the visiting cruise vessels will need to be ready to operate shore power and that there could be a high risk for ports and cruise lines of missing out on itineraries and cruise calls if not in compliance.

6.2.4 Ship design

Antifouling hull coatings

To remove and prevent biofouling (an environmental challenge that leads to the spread of IAS and increases the ship's drag), **marine vessels apply anti-fouling coatings or paint to the hull**. This prevents the accumulation of invasive aquatic species and reduces frictional resistance (which in turn leads to better fuel performance). This concept is not new to the maritime industry; even from the early days of sailing ships, lime and later arsenic were used to coat ship hulls.

Non-toxic coatings are used, such as hydrophobic foul-release coatings, copper-free antifouling paints (which repel rather than kill organisms), and nano antifouling coatings (which create surfaces too slippery for organisms to attach to).[165]

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[158] Oxford Economics. 2021. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/clia-media/research/2021/economic-impact/clia-env-study---11-01-2021---final.ashx
[159] De Carvalho, Luis. 2021. Email exchange and report review (22/10/2021).
[160] ESPO. 2021. ESPO Environmental Report 2021. https://www.espo.be/media/ESP-2844%20(Sustainability%20Report%202021)_WEB.pdf
[161] Sukharenko, Danielle. 2019. Shore power lacks global investment, tax exemptions. Journal of Commerce (JOC). https://www.joc.com/maritime-news/container-lines/shore-power-set-back-insufficient-legislation-high-electricity-costs_20190729.html
[162] European Commission. 2022. European Green Deal. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[163] European Commission. 2021. Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU of the European Parliament and of the Council. https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021PC0559
[164] EAFO. 2021. Port infrastructure: OPS Technology. https://www.eafo.eu/shipping-transport/port-infrastructure/ops/technology
[165] Safety 4 Sea. 2018. Understanding marine biofouling: how anti-fouling systems prevent growth. https://safety4sea.com/cm-understanding-marine-biofouling-how-anti-fouling-systems-prevent-growth/

The CLIA[166] reports that these alternative coatings can reduce fuel consumption by 5%, resulting in their widespread use by the cruise tourism industry (77% of CLIA member ships use these antifouling measures).

Optimising hull design

Designing ships to operate more energy-efficiently can contribute to reducing GHG emissions. Optimising the hull design can make a significant contribution. The CLIA[167] reports that a more bulbous bow design on cruise ships reduces fuel usage for propulsion by upwards of 15% when compared to the more traditional V-shape.

Little data exists on the extent to which cruise ships have adopted this design measure.

Vessel size

Theoretically, an argument can be made for both larger and smaller ships. Large cruise ships are associated with greater gross environmental impacts such as air pollutant emissions and discharges, since they require greater quantities of inputs such as fuel, energy, water and food. However, larger ships enjoy greater economies of scale, so that marginal environmental impacts are smaller per passenger. However, there is less risk of collisions with marine life from smaller ships. **There is little research on the pros and cons of either.**

6.2.5 Voyage optimisation

Speed optimisation

By deliberately reducing their speed, cruise ships can reduce fuel consumption and the associated costs, since "slow steaming" can improve the efficiency of the main engines.[168] Even slight reductions in the cruising speed can substantially affect fuel consumption. Reducing the speed of a ship by 10% may decrease the related CO2 emissions by at least 10-15%[169], although these estimates apply to maritime as a whole and are not specific to cruise ships. Decreasing speed can also reduce SOx, NOx, and BC emissions, as well as noise, vibration and collisions with marine life.[170]

However, reducing speed increases the travel time, implying that the benefits of reduced fuel consumption may be offset by the total length of the ship's voyage, which has a cost[171]. Furthermore, reducing speed below the range within which the ship is designed to operate could ultimately affect the performance of the engines, potentially reaching critical loads and increasing maintenance costs. The benefits have to be weighed against the disadvantages so that speed is not just reduced but optimised.

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[166] Oxford Economics. 2020. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/research-updates/research/clia-environmental-study-report.ashx

[167] Oxford Economics. 2020. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/research-updates/research/clia-environmental-study-report.ashx

[168] EMSA. 2021. European Maritime Transport Environmental Report {EMTER) 2021. https://www.eea.europa.eu/publications/maritime-transport

[169] EMSA, 2019, 'CO2 emission report', EMSA/Thetis MRV, European Maritime Safety Agency. https://mrv.emsa.europa.eu/#public/ emission-report.

[170] Leaper, R. 2019. 'The role of slower vessel speeds in reducing greenhouse gas emissions, underwater noise and collision risk to whales', Frontiers in Marine Science 6, p. 505 https://doi. org/10.3389/fmars.2019.00505.

[171] EMSA. 2021. European Maritime Transport Environmental Report (EMTER) 2021. https://www.eea.europa.eu/publications/maritime-transport

Route optimisation

Onboard or remote data-driven systems can assist ship captains in optimising routes, yielding fuel savings and reduced GHG emissions. These systems combine historical route data, simulated weather forecasts, ship specifications and input from the ship's captain (expertise and situational awareness) to model optimal route predictions and provide real-time operational guidance to the crew.

Little data exists outlining the extent to which these systems are being used by the cruise tourism industry, although evidence from some of the major cruise operators suggests they are increasingly being used. For example, Royal Caribbean employs a Predictive Route Optimization System on over 50% of its fleet.[172]

Trim and draught optimisation

The trim of a ship can have a significant impact on a vessel's draught. That in turn dictates its energy consumption for propulsion. The most efficient trim for a particular ship depends on its design, operational draught and speed.

Several marine technology providers such as Wärtsilä[173] offer trim optimisation models which model the vessel's hydrodynamic characteristics in real-time using sensors installed on the vessel hull. A by-product of these systems is the added ability to evaluate the effect of biofouling on the ship's hull performance.

In general, little data exists outlining the extent to which this system is being used by the cruise tourism industry. Nonetheless many of the major cruise operators indicate that they are being used on the majority of their fleet.

Port call optimisation and smart docking systems

Ports, in cooperation with ships, play an important role in optimising cruise ship performance during berthing. A port call is a key aspect in the cruise tourism supply chain, but a potential bottleneck. Data-driven and strategic communication from port control can assist ships to optimise a variety of aspects of the docking process, including speed, draught, manoeuvring (with the use of smart-docking systems), and time in port, all of which contribute to optimising 'just-in-time' arrivals, thereby resulting in cost savings and local environmental benefits. This communication is not limited to 'port-to-ship' but can also seek to optimise operations in the wider port and associated supply chains.[174]

Data analysis and automation

All the voyage optimisation measures outlined above are underpinned by effective and targeted data analysis, and the cruise industry (both ship operators and port authorities) have long been among the proponents of voyage optimisation data analysis. Data-driven digital solutions can optimise not only vessel-level decisions, such as route and trim, but also specific internal components and functions, such as engine utilisation[175]. Moreover, data analysis offers flexibility to cruise tourism stakeholders since it can be applied not only to new builds, but also retrofitted onto existing ships.

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[172] Royal Caribbean Group. 2020. Sustainability Report. https://sustainability.rclcorporate.com/reporting/
[173] Wartsila. 2021. Wartsila Trim optimised by Eniram. https://www.wartsila.com/marine/voyage/voyage-and-vessel-efficiency/voyage-efficiency/wartsila-trim
[174] International task Force on Port Call Optimization. 2018. 'Port call optimization'. https://portcalloptimization.org
[175] Oxford Economics. 2020. Environmental commitment, innovation, and results of the cruise industry: report produced for Cruise Lines International Association (CLIA). Cruising.org. https://cruising.org/-/media/research-updates/research/clia-environmental-study-report.ashx

Evidence of the extent to which cruise stakeholders utilise data-driven solutions is unclear, but they are certainly in use (Box 7).

Box 7 Using data to optimise operations

MSC Cruises[176] continuously monitors its fleet operations from their Maritime Support Centre. Remotely based in London, this Centre supports decision-making by collecting and analysing data on various components of ship operations such as routes, speed, engine performance and emissions data to then be fed back to the operational crew. As an example of recent advanced technological support measures, MSC Cruises has begun utilising this data to formulate a digital twin ship, which allows them to compare actual operating data onboard ship with the ship's design parameters, thereby supporting the identification of efficiency gains.

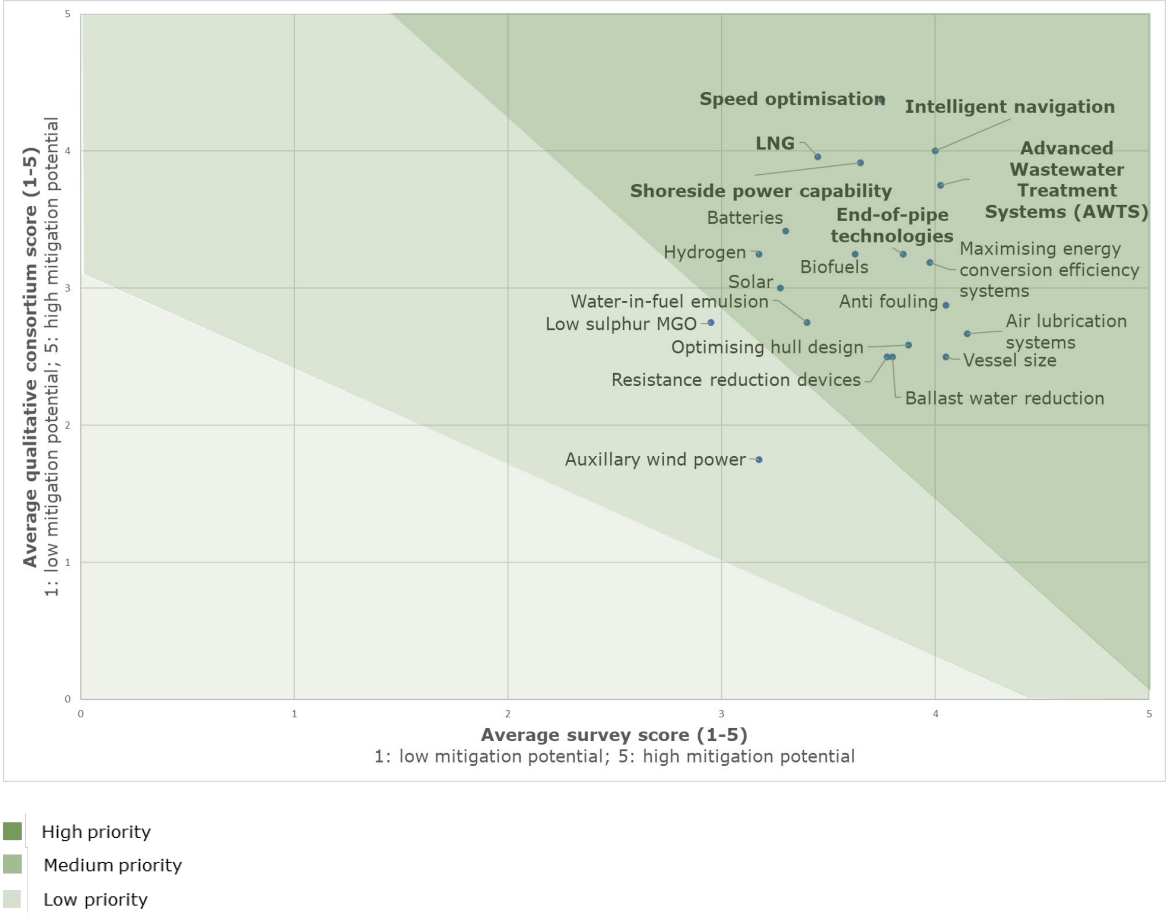
6.3 Making choices

To help the industry in making choices between different solutions, this study carried out a materiality assessment of the solutions based on scores attributed to the different challenges by the study consortium's experts and a survey of external experts[177](Figure 27). (A matching exercise of identifying challenges and their materiality is in the first previous part of this chapter).

[176] MSC Cruises. 2020. Charting our sustainable future: 2019 sustainability report. http://viewer.zmags.com/publication/ad7ec97d#/ad7ec97d/24

[177] These are qualitative assessments which suggest which topics should be looked at more closely. They should not be taken as producing a relative comparison of the challenges or solutions as it is inherently difficult to compare, for example, whether noise pollution is a more serious challenge than bilge water.

Figure 27 Integrated materiality assessment of green technological solutions



Source: Deloitte/Ramboll analysis

The solutions which should be regarded as high priority are:

- **Fuel use: LNG; liquid and gaseous biofuels (including bio-methane); ammonia, water-in-fuel emulsion; hydrogen, hydrogen-derived fuels;**
- **Systems: end-of-pipe technologies; advanced wastewater treatment systems (AWTS);**
- **Voyage: speed optimisation; intelligent navigation;**
- **Shoreside: shoreside power capability/OPS/cold ironing**;

Other high priorities, but around which there was less consensus, are systems to maximise energy conversion efficiency; batteries and fuel cells; sustainable onboard waste management; and air lubrication systems; anti-fouling (e.g. hull coatings); ballast water reduction; resistance reduction devices; optimising hull design and vessel size.

Medium priorities are: Low sulphur marine gas oil (MGO) and auxiliary wind and power.

There were **no low priority solutions**.

Box 8 Upstream and downstream solutions

The materiality assessment above focused on emissions to air and water. However, there are **upstream and downstream challenges** not considered in the materiality assessment that need to be borne in mind when looking at the overall picture:

Other upstream solutions

 Sustainable supply chain (food and other inputs)

The large quantities of inputs required by cruise ships to cater for their passengers and crew depend upon efficient supply chains. Passengers themselves are increasingly demanding sustainable products and services in response to growing awareness of the climate crisis. Therefore, many cruise operators are strategically sourcing inputs from sustainable (and, where possible, local) supply chains and adopting the principles of the circular economy. Environmental labelling and certifications, such as that of the Marine Stewardship Council (which certifies sustainable seafood sources), are emerging as key systems in place to facilitate this trend.

Downstream solutions

 Sustainable shore excursions

This is explored as part of the case study assessment. However, as an indicative example of this solution, in Hawaii, cruise companies including Royal Caribbean and Norwegian Cruise Lines have started working with local NGOs such as the Sustainable Tourism Association of Hawaii to ensure the shore excursions by local operators are Global Sustainable Tourism Certified. Luxury cruise operator Ponant created the Ponant Foundation in 2018 to promote sustainable tourism and support local projects focussing on research, awareness-raising and conservation.

Other

 Alternative business models

Alternative business models, such as slow cruise tourism, may have potential to minimise some of the environmental challenges associated with the industry. Because alternative business models are not considered technological solutions, they are not examined as part of this report.

6.4 Navigating the uncertainties

Overall, the decision by relevant stakeholders to invest in green technological solutions is a difficult one. There is no winner-takes-all technology. Rather, a basket of technological solutions is required that responds to each specific context (location, cruise ship, etc.) Addressing fuel consumption and emissions will make a major difference, but can usefully be coupled with energy efficiency, OPS and optimisation measures.

However, there are major obstacles to be considered and addressed, including:

- energy costs;
- low maturity and commercialisation of alternative technologies, with high investment risks for first movers (especially in fuel supply and demand). The uncertain return on investment for green technological solutions is also attributable to the uncertainty regarding the use and income from use by vessels;

- lack of predictability in the regulatory context (although this has been, at least partially, addressed with some of the legislative proposals of the Fit-for-55 package) and overall volatility of energy markets;
- technology timeframes that are hard to predict, with solutions today perhaps not being solutions for tomorrow.[178] The average cruise ship has a 40-year life cycle. Making a decision now about its technological capabilities runs the risk of ending up with stranded assets;[179]
- lack of supporting infrastructure to cater for and supply technological solutions;
- lack of coordination and cooperation with other relevant stakeholders.

Energy cost and infrastructure requirements across the supply chain are key drivers/barriers for the uptake of any alternative fuel, and there is high uncertainty about the expected price/cost ratio of the fuels with significant GHG reduction potential.[180] As a central principle, it is likely that any major uptake of alternative fuels will depend largely on R&D efforts, regulations and incentive schemes to make them more competitive with traditional fuels.

Low-regret options (such as those improving energy efficiency) can be implemented in the short term to capture immediate gains and help abate the costs of larger technological investments. Fuel flexibility is also recommended as the best hedging option against technological and investment uncertainty. Dual-fuel technology is emerging as the best hedging option against the inherent uncertainty in the future fuels landscape. Given the various actors and supporting bodies involved in the cruise industry, these suggestions apply not only to cruise operators but to all relevant stakeholders, such as ports, cities, governments, energy companies and technology providers. The Fit-for-55 package's proposed legislation and supporting programmes, such as Horizon Europe and the Innovation Fund for the demonstration of innovative low-carbon technologies, can make positive contributions.

Effective implementation of green technological solutions will require coordination and support between stakeholders (especially between fuel suppliers, ports and cruise lines). As part of this improved coordination, a clear regulatory landscape needs to be in place to enhance the predictability of an uncertain technological and energy landscape.

It is important to create a platform for healthy dialogue in which all parties, including regulators, can participate to create a shared understanding of everyone's concerns, limitations, and progress, and work together for practical solutions over the short, medium and long run. The Renewable and Low-Carbon Fuels Value Chain Industrial Alliance[181] is an initiative that focuses on boosting production and supply of renewable and low-carbon fuels in the aviation and waterborne sectors. It is a key flanking measure to the FuelEU Maritime initiative[182].

Many of the green technological solutions investigated are inhibited by low technological and/or commercial maturity. Where possible, technology development and production should be stimulated on a larger scale to speed up the technology deployment pathway (or 'S curve of innovation') as well as lower costs to levels that promote their uptake. To this end, the industry may need to tap into the wider green

[178] Teleconference interview conducted 18/06/2021
[179] Teleconference interview conducted 19/05/2021.
[180] DNV GL. 2019. Assessment of Selected Alternative Fuels and Technologies. Report
[181] European Commission. 2022. Renewable and Low-Carbon Fuels Value Chain Industrial Alliance. https://transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/alternative-fuels-sustainable-mobility-europe/renewable-and-low-carbon-fuels-value-chain-industrial-alliance_en
[182] European Commission. 2021. Proposal of the European Parliament and of the Council on the use of reneable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC. https://ec.europa.eu/info/sites/default/files/fueleu_maritime_-_green_european_maritime_space.pdf

finance industry to avoid capital constraints on decarbonisation. To improve scalability, technological solutions should be developed with a view to having a broad multiplier effect enabling the majority of the maritime industry to use the technology[183].

In the meantime, **cruise tourism industry stakeholders should pursue transparency and reporting.** Many of the key actors have begun pursuing this with the publication of annual sustainability reports. As part of this, impact assessments should be localised to avoid applying blanket assumptions about environmental pressures and impacts.[184] This will help to bridge the data gaps observed in the literature reviewed. Additionally, stakeholders are encouraged to develop their alignment with EU taxonomy regulations as a means of enabling consistent reporting and definitions of sustainability.

These are tasks for the different players of the ecosystem working together. The respective roles are illustrated in the following sustainability roadmap.

Table 7 High-level roadmap of recommended sustainability measures

	Description	Relevant stakeholders					
		Cruise operators	Ports	Industry associations	Destination associations	Technology providers	Government/ policymakers
Short-term measures	Develop clear and transparent environmental goals; conduct regular reporting (including alignment with the new EU taxonomy reporting requirements [185]); coordinate and align environmental goals across industry stakeholders, stakeholder coordination to facilitate information-sharing and deployment of sustainable solutions.	x	x	x	x	x	x
	Implement efficiency-improving measures, including: - optimisation of navigation systems (includes speed and route optimisation) - (renewable-energy-based) OPS - hull coatings - hybrid battery systems.	x	x	x		x	x
	Develop fuel flexibility capabilities (capacity to utilise drop-in renewable fuels).	x	x	x		x	x

[183] Teleconference interview conducted 11/05/2021
[184] Teleconference interview conducted 11/05/2021
[185] The EU taxonomy aims at defining which economic activities (including maritime transport) can be considered as sustainable as per European legislation. The definition of sustainability includes social elements on top of environmental objectives, and for an economic activity to be considered taxonomy-compliant it must: a) Contribute substantially to one or more of the environmental objectives; b) Do No Significant Harm to any other environmental objective; and c) Comply with minimum social safeguards

	Description	Relevant stakeholders					
		Cruise operators	Ports	Industry associations	Destination associations	Technology providers	Government/ policymakers
	Adopt circular economy principles across the entire supply chain (including sustainable certification; eliminating single-use plastics; eco-design solutions that use recycled or recyclable material; use micro-plastics-free products.	x	x	x	x	x	x
	Facilitate sustainable shore excursions and destination management with relevant partners (includes renewable-energy-based activities and services).	x			x		x
Mid-term measures	Accelerate the installation of supporting infrastructure and supply chains in ports and hinterlands (including renewable-energy-based OPS).		x	x		x	x
	Further phase out sulphur from fuels and develop low-emission fuels by committing to R&D and other accompanying efforts.	x	x	x		x	x
	Promote and improve good management practices and technological innovations in relation to waste discharges.	x	x	x		x	x
Long-term	Roll out chosen zero-emission technologies for the entire fleet and associated infrastructure.	x	x	x		x	x

Source: Deloitte/Ramboll analysis

6.5 Findings

The assessment of the potential green technological solutions to the challenges identified in the previous chapter reveals a landscape that is nuanced and uncertain. Each solution has both advantages and disadvantages, and these change in line with technological advances and global megatrends within energy production. The period to **2030 will be a key period for R&D, piloting, product development and commercialisation.** In the meantime, cruise tourism players – including the ports and destinations discussed in the next two chapters – capture energy efficiency gains, develop fuel flexibility potential and put environmental, circular economy and destination management goals and carry out impact assessments with little fear that this will be wasted effort.

CHAPTER 7: CRUISE TOURISM – SOCIAL CHALLENGES AND SOLUTIONS

7.1 Introduction

When discussing sustainability, the topic of **social sustainability is often eclipsed by the environmental and economic pillars of sustainability**. Nonetheless, it is an integral part of sustainability and future EU developments, such as the proposed Corporate Social Responsibility Directive[186], are likely to bring it further to the fore. This chapter reviews the existing international and EU regulatory frameworks regulating the living and working conditions of crews, and health and safety. It also points to some examples of good practice.

7.2 Diverse employment profiles

Under normal circumstances (i.e. in the period before the COVID-19 crisis), the cruise tourism industry employed **some 250 000 seafarers**.[187] Crew sizes range from 300 on the smaller ships to 2 100 seafarers on the largest ships; typically between 700 and 1500 seafarers work on a given cruise ship.[188] Cruise ship crews tend to be geographically diverse, with crew members coming primarily from South East Asia, South America, and Eastern and Western Europe.[189]

The **roles and responsibilities on a cruise ship are varied**. Some seafarers work in the deck department which covers **navigation, safety and security**. They include captains, staff captains, chief mates, deck officers, and security officers who work together with deckhands and other seamen. The technical department, which covers the ship's **engine, electricity, electronics, sanitation and environmental protection**, employs chief engineers, engineer officers and ratings specialising in technical issues. These two categories of seafarers have professional maritime training and may have worked on different types of ships before.

In addition, there are seafarers working in **hospitality**, who provide services covering food and beverage, housekeeping, laundry, spa, medical services, entertainment, photography, retail, casino, IT, crew office, shore excursions, and youth/children's activities. The seafarers in this category include the hotel manager, cruise director, food and beverage manager, head chef, chief purser, casino manager, housekeeping manager and music director, bar and restaurant waiters, cabin stewards, etc.

Like most shipping jobs, working on a cruise ship can be labour-intensive. It is characterised by long hours and seven-day work weeks interchanged with long rest periods.[190] Prolonged separation from loved ones, limited personal space and occupying tight quarters with crew members from various previously unfamiliar backgrounds (particularly for staff working in the hotel part of the ships), also shape the experience of

[186] In April 2021, the European Commission adopted a proposal for a Corporate Sustainability Reporting Directive (CSRD), which aims to amend Directive 2014/95/EU (the Non-Financial Reporting Directive) by extending its scope to all large companies and all companies listed on regulated markets; requiring audits (assurance) of reported information; introducing more detailed reporting requirements, incl. a requirement to report according to mandatory EU sustainability reporting standards, etc. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0189

[187] Radic, A. (2019). Occupational and health safety on cruise ships: Dimensions of injuries among crew members. Australian Journal of Maritime & Ocean Affairs, 11(1), 51-60.

[188] Terry, W. C. (2011). Geographic limits to global labor market flexibility: The human resources paradox of the cruise industry. Geoforum, 42(6), 660-670.

[189] Weaver, A., & Duval, D. T. (2008). International and transnational aspects of the global cruise industry. In International Business and Tourism (pp. 120-137). Routledge.

[190] Exarchopoulos, G., Zhang, P., Pryce-Roberts, N., & Zhao, M. (2018). Seafarers' welfare: A critical review of the related legal issues under the Maritime Labour Convention 2006. Marine Policy, 93, 62-70.

seafarers.[191] [192] [193] In some cases, differences between cultures can result in reports of harassment.[194] [195]

7.3 The international regulatory framework

There is an extensive international regulatory framework to guarantee minimum standards through the International Labour Organization (ILO) Maritime Labour Convention (MLC, 2006).[196]

The original MLC, 2006 has been amended three times: to address the financial security of seafarers in cases of abandonment and contractual compensation in the event of the death or long-term disability of seafarers (in 2014); to address bullying and harassment in the workplace (in 2016), and to require that Flag States provide adequate financial security to cover the costs of abandonment of seafarers as well as claims for death and disability due to occupational injury (in 2018).

The key provisions can be broken down into four main categories:

- **minimum requirements for seafarers to work on a ship;**
- **conditions of employment;**
- **accommodation, recreational facilities, food and catering (living conditions);**
- **health protection, medical care and social security protection.**

A survey, interviews and a literature review were carried out to assess whether experts believe that the conditions are being met. The conditions outlined in the Figures in the next section are based on MLC, 2006.

[191] Bolt, E. E. T., & Lashley, C. (2015). All at sea: Insights into crew work experiences on a cruise liner. Research in hospitality management, 5(2), 199-206.
[192] Tarlow, P. E. (2017). Cruises, safety and security in a violent world. Cruise ship tourism, (Ed. 2), 236-257.
[193] Exarchopoulos, G., Zhang, P., Pryce-Roberts, N., & Zhao, M. (2018). Seafarers' welfare: A critical review of the related legal issues under the Maritime Labour Convention 2006. Marine Policy, 93, 62-70.
[194] Klein, R. A., & Poulston, J. (2011). Sex at sea: Sexual crimes aboard cruise ships. Tourism in Marine Environments, 7(2), 67-80.
[195] Winter, S., & Papathanassis, A. (2020). Sexual Harassment During Tourism and Cruise Internships: Exploring Situational Factors, Causes, and Their Implications. Tourism in Marine Environments, 15(2), 85-94.
[196] https://www.ilo.org/global/standards/maritime-labour-convention/lang--en/index.htm

7.3.1 Minimum conditions

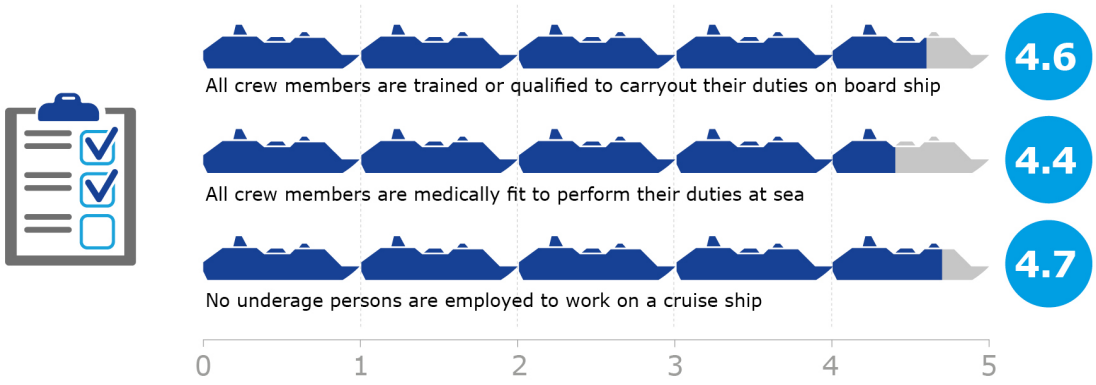
Figure 28 Minimum requirements

Minimum requirements for seafarers to work on a ship
No underage persons are employed
All crew members are medically fit to perform their duties at sea
All crew members are trained or qualified to carry out their duties on board ship
All crew members have access to efficient and well-regulated recruitment

Source: Deloitte/Ramboll analysis

Respondents to the survey tended to fully agree that the minimum requirements are being met. The highest consensus was around the fact that **there is no underage employment** (4.7 on a scale of 5). There was also a high level of agreement that **crew members are trained or qualified, and medically fit** (Figure 29).

Figure 29 Results of the scored survey (minimum requirements)



Source: Deloitte/Ramboll analysis

Interviews with experts supported these findings. Seafarers undergo medical examinations before embarking on ships and safeguards, such as the International Convention on Standards of Training, Certification and Watchkeeping (STCW Convention),[197] ensure that the seafarers are qualified to carry out their responsibilities. A labour union representative agreed that "*The maritime industry is highly regulated when it comes to health and safety, you need to justify and demonstrate that seafarers are qualified and are able to do the tasks they are supposed to do.*"

However, seafarers **do not always have equitable access to recruitment and placement services**. According to the majority of interviewees (especially stakeholders representing trade unions and academia) and some of the literature examined[198], some labour-supplying countries, such as Indonesia, India and Nicaragua, are examples of practices such as asking seafarers to pay placement fees to get an interview for a job

[197] The STCW Convention was incorporated into EU law by Directive 2008/106/EC on the minimum level of training of seafarers. Directive 2008/106/EC was amended by Directive 2012/35/EU so as to bring it in line with the latest amendments to the STCW Convention, namely the so-called 'Manila Amendments'. https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32022L0993.
[198] Terry, W. C. (2011). Geographic limits to global labor market flexibility: The human resources paradox of the cruise industry. Geoforum, 42(6), 660-670.

position, to take unnecessary courses or undergo medical examinations that are not required. According to one labour union representative, "*This is very prevalent; in the Philippines, they have more government oversight.* [199] *In countries like India and Indonesia, it's widespread.*"

The interviews with representatives of academia and a trade union supported evidence found in the literature that **some seafarers may have to take out loans to pay these placement fees**. "*That makes them more prone to agreeing to work that much harder*," according to a Labour union representative. In some cases, staffing agencies also impose stringent selection requirements (e.g. height, physical appearance) for some positions such as hotel staff, which may limit access to qualified seafarers.

Interviews with trade union representatives and the literature reviewed suggest that cruise companies and trade unions aim to identify and blacklist companies not complying with the requirements, and that cruise companies ensure they are compliant by establishing **training centres in labour-supplying countries** in order to train and hire directly rather than search for qualified staff.[200] Such centres cover different departments and skills. **Building long-term and direct relationships with the staffing agencies, as well as conducting anti-bribery checks, establishing hotlines for complaints**, and checking for compliance with the MLC are also reported by cruise industry representatives as preventing less favourable practices.

7.3.2 Living conditions

Figure 30 Living Conditions for Seafarers

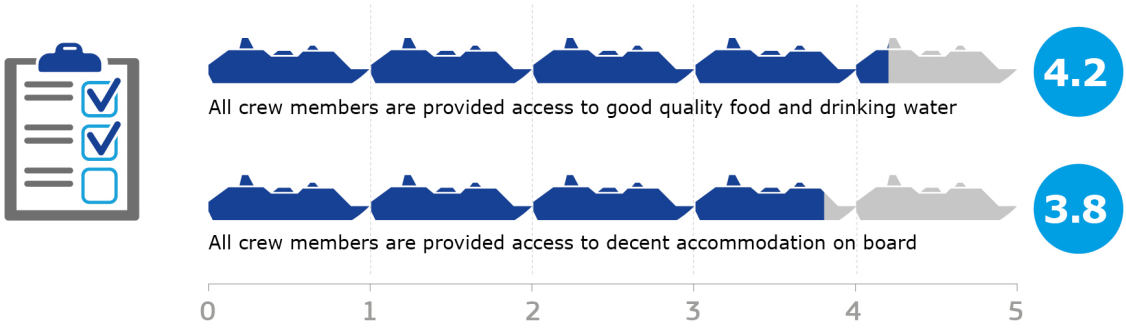
Living condition requirements
All crew members are provided access to decent accommodation on board
All crew members are provided access to good quality food and drinking water

Source: Deloitte/Ramboll analysis

The survey results suggest that requirements on living conditions are met but less well than the conditions of employment. While the majority concurred, the score for the provision of good quality food and drinking water was 4.2 and dropped to 3.8 for the of decent accommodation (Figure 31).

[199] Through the Philippines Overseas Employment Administration (POEA)
[200] Ibid.

Figure 31 Results of the scored survey (living conditions)



Source: Deloitte/Ramboll analysis

However, there is evidence that **living conditions have improved over time**. According to one representative of a trade union, the number of seafarers per cabin has decreased (*"[Cabins] are built to minimum standards; some are built a little bit better…not too many companies build cabins for 3 or 4 members but for 2 or 1."* However, several interviewees noted that other ships typically offer private cabins and more personal space (*"Mostly, on cargo, there is one crew member in a cabin, while this only applies to officers on cruise ships." — Labour union representative*). This is to some extent offset by the fact living on a cruise ship affords access to medical personnel and more amenities (e.g. access to a swimming pool, gyms, crew bar, recreation rooms, etc.)

Food is a matter of taste. **The variety of food options can sometimes be an issue** because it often caters to the preferences of the more predominant nationalities onboard leaving some seafarers dissatisfied (*"It is very difficult to satisfy these many nationalities in terms of food and culture."* — Labour union representative). **Establishing a crew food committee onboard**, which aims to collect feedback and propose enhancements in food variety and representation, can address this.

Some of the literature reviewed and interviews underscored the importance of **reliable access to the internet** for the mental well-being of seafarers. Its role was made particularly clear during the onset of the COVID-19 crisis when many seafarers were stranded at sea for months (*"The internet issue became crucial during the pandemic."— Labour union representative*). While seafarers have access to the internet at ports (e.g. when they visit seamen's clubs or when seamen missions go on board to provide a wi-fi connection), not all ships offer a free internet connection to seafarers.

7.3.3 Conditions of employment

Figure 32 Employment condition requirements

Conditions of employment
All crew members are provided fair employment agreements
All crew members are paid for their services
All crew members have regulated hours of work or hours of rest
All crew members have adequate leave
All crew members have the right to be repatriated at no cost to themselves
The crewing power of cruise ships is sufficient to ensure safe, efficient and secure operation
Opportunities for career progress and skill development are provided
The human rights of all crew members are respected
No forced labour practices are employed on cruise ships
No employment-related discrimination based on gender, race, colour, sex, religion, political opinion, national extraction or social origin

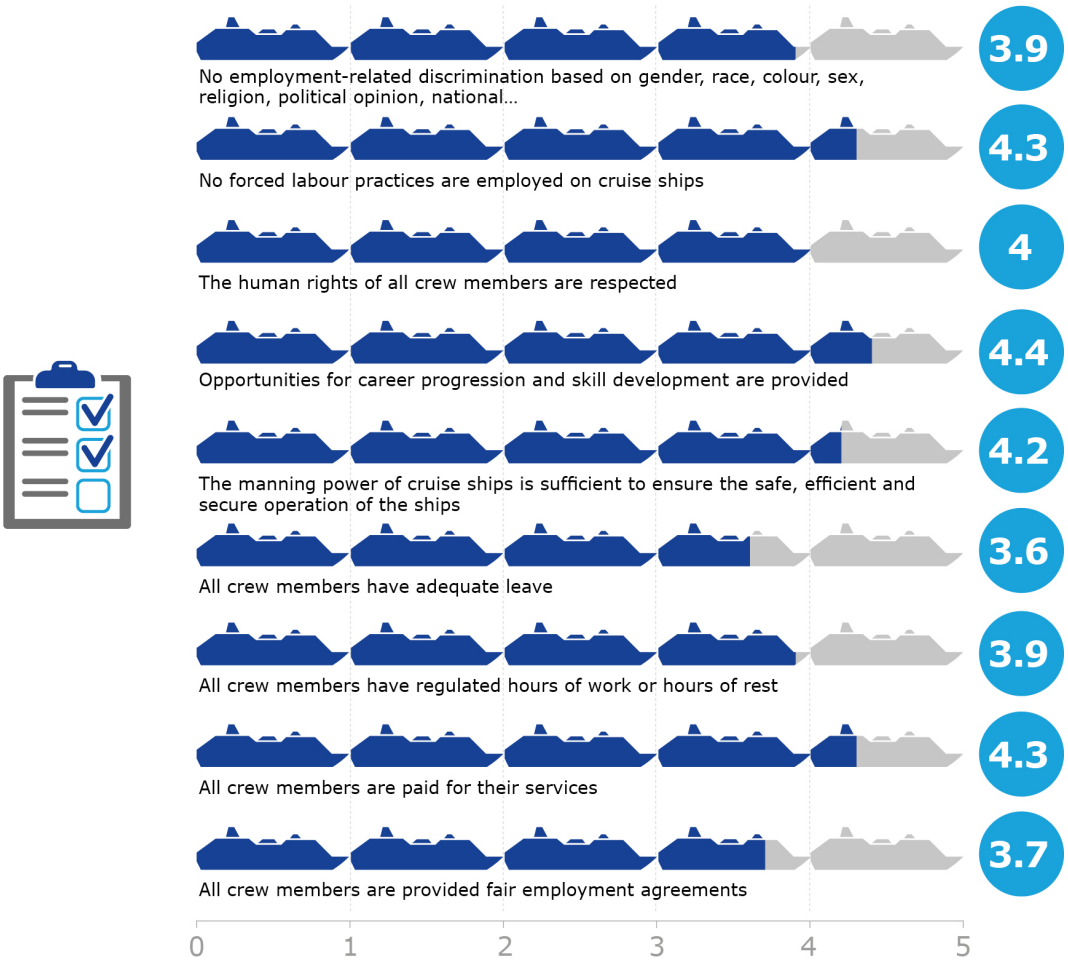
Source: Deloitte/Ramboll analysis

The results from the scored survey (Figure 33) show that respondents' opinions of the respondents were overall positive, but that they were **most likely to agree** that **seafarers on cruise ships have access to opportunities for career progression and skill development** and that **they are paid for their services,** and **least likely to agree** that they are **afforded adequate leave and fair employment agreements**.

The expert interviews indicated that the conditions of employment differ significantly between cruise companies, and it is not possible to provide a general overview ("*There is a great difference between the various companies in the way they treat their employees and in how much information they disclose*." — Labour union representative). **Lack of rest, unpaid overtime and lack of shore leave** were cited as the main issues. Some evidence suggests that the workdays are ten to twelve hours long (with breaks in-between), that seafarers typically work seven days a week[201] and no overtime is paid. **Using check-in/out cards, which monitor how many hours seafarers have worked, has been useful in resolving conflicts.**

[201] Radic, A. (2019). Occupational and health safety on cruise ships: Dimensions of injuries among crew members. Australian Journal of Maritime & Ocean Affairs, 11(1), 51-60.

Figure 33 Results of the scored survey (conditions of employment)



Source: Deloitte/Ramboll analysis

In general, seafarers spend on average between four and seven months onboard[202] and significantly longer stays are not uncommon (up to 11 months per year as allowed by the MLC, 2006[203]). Some seafarers – primarily those with higher positions in the hierarchy of the ship, spend shorter periods of time onboard. These seafarers are typically paid for the period when they are off. This is not always the case with seafarers in lower positions from Asia and Eastern Europe. Their contracts are much longer, e.g. 10 months, and they are not always employed while they are back in their home countries. While some sources insist on the need to reduce the length of all contracts to fewer than 6 months[204], one interviewee noted that it is also **important to consider what the seafarers prefer and for them to have options**. Nonetheless, several literature sources and stakeholders noted that this contract-based employment results in a lack of job security[205] *("Almost all of the employment is contract-based – you are hired and when the contract ends, you*

[202] Ibid.
[203] https://www.ilo.org/global/standards/maritime-labour-convention/lang--en/index.htm
[204] Exarchopoulos, G., Zhang, P., Pryce-Roberts, N., & Zhao, M. (2018). Seafarers' welfare: A critical review of the related legal issues under the Maritime Labour Convention 2006. Marine Policy, 93, 62-70.
[205] Bolt, E. E. T., & Lashley, C. (2015). All at sea: Insights into crew work experiences on a cruise liner. Research in hospitality management, 5(2), 199-206.

have no job. The company wants you back again because you are trained but they don't have to take you." – Labour union representative).

According to the MLC, 2006[206], **shore leave is important for the benefit of the health and well-being of seafarers**. However, the evidence suggests that whether or not seafarers are granted shore leave depends on the Port States (*"There were issues with the enforcement of the regulations and steps taken to declare seafarers "key workers" in some of the ports." — Labour union representative).* According to the evidence collected via interviews, *lack of shore leave and working overtime could prevent seafarers from getting enough rest*.[207]

Another tenet of the MLC, 2006[208] is the right of seafarers to be repatriated at no cost to themselves (e.g. at the end of their contract or in case of injury). The evidence collected suggested that **repatriation is not always possible**. For example, one interviewee noted that seafarers cannot be repatriated from Sweden due to a national restriction in the context of the Schengen agreement. However, **cases of complete ship abandonment are very rare**. According to the International Labour Organisation[209] Abandonment of Seafarers database, only seven cruise ships were abandoned between 2004 and 2021. Nevertheless, many seafarers remained stranded at sea for months at the beginning of the COVID-19 crisis because some governments refused to support their repatriation when confronted with a crisis unprecedented in nature.[210]

Another important factor that influences working conditions is the **availability of opportunities for career progression and skill development**. The evidence collected via the interviews suggests that there is a variation between companies. In general, it was reported that more incentives are provided for positions which are difficult to fill (e.g. back engine staff) in order to retain qualified staff. For positions that are regarded as easier to fill (e.g. catering, housekeeping), there is less emphasis on training and advancement. Nonetheless, the data collected suggests that cruise companies do try to provided opportunities to the seafarers they hire.

Both the literature reviewed [211] [212] and some of the stakeholders interviewed highlighted that **seafarers from developed countries tend to occupy higher positions** within the hierarchy of a cruise ship. Taken at face value, this could be an indicator of employment-related discrimination and the 3.9 in the survey points in that direction. However, European maritime education is highly regarded and graduates from European academies are more sought after to work on cruise ships. Additionally, cruise companies, which are typically European and North American, may have a preference for seafarers from their countries occupying the more senior positions on board. Lastly, the wages for lower positions are not competitive in the European market. Thus, seafarers who are engaged in menial tasks are mostly from poorer countries. As a result, while salaries are determined by position, it may appear as if wage stratification is linked to nationality because certain nationalities tend to occupy specific positions.[213]

[206] https://www.ilo.org/global/standards/maritime-labour-convention/lang--en/index.htm
[207] Ibid.
[208] https://www.ilo.org/global/standards/maritime-labour-convention/lang--en/index.htm
[209] https://www.ilo.org/dyn/seafarers/seafarersBrowse.list?p_lang=en
[210] https://graphics.reuters.com/HEALTH-CORONAVIRUS/PHILIPPINES-CRUISESHIPS/xegvbkeaqpq/index.html
[211] Terry, W. C. (2011). Geographic limits to global labor market flexibility: The human resources paradox of the cruise industry. Geoforum, 42(6), 660-670.
[212] Weaver, A., & Duval, D. T. (2008). International and transnational aspects of the global cruise industry. In International Business and Tourism (pp. 120-137). Routledge.
[213] Terry, W. C. (2011). Geographic limits to global labor market flexibility: The human resources paradox of the cruise industry. Geoforum, 42(6), 660-670.

Cruise ships have the highest proportion of female seafarers.[214] Nonetheless, the evidence collected via the interviews shows that **several factors can dissuade women from a career on a cruise ship**, such as the length of the contracts (which would require them to be away from their families for prolonged periods), the general perception that being a seafarer is not a suitable occupation for a woman and perceived vulnerability.

7.3.4 Health protection, medical care, social security protection

Figure 34 Health protection, medical care and social security requirements seafarers

Health, medical and social security requirements
The health of all crew members is protected and prompt access to medical care on board ship and ashore is ensured
All crew members are protected from the financial consequences of sickness, injury or death occurring in connection with their employment
The work environment on board cruise ships promotes occupational safety and health
All crew members have access to shore-based facilities and services to secure their health and well-being
All crew members have access to social security protection

Source: Deloitte/Ramboll analysis

Considering the labour-intensive character of the work on cruise ships, access to good medical care is essential. Some of the most common medical problems are musculoskeletal injuries; slipping, stumbling, and falling; and contact with physical objects and liquid substances. Some of the most common causes are the physically demanding nature of some tasks and their frequent repetition; fatigue due to long contracts and working hours, time pressure and complacency; and construction characteristics (such as deck surfaces).[215] Some good practices, especially relevant for hotel staff, are presented in Box 10[216].

Unlike cargo ships, cruise ships have a doctor onboard, who attends to any medical issues that may arise. According to the MLC, 2006[217], cruise companies should cover the medical costs until a doctor states that he/she has done what is medically possible and make a one-time payment (USD 100 000 – 200 000) in cases of disability. Additionally, if seafarers are unable to work for medical reasons, they should receive a salary for up to 16 weeks. According to the evidence collected via the interviews, large cruise companies have **well-established procedures** for complying with the requirements.

However, it is not uncommon for trade unions to receive complaints that the rights of the seafarers have not been respected. In many cases, these complaints are settled quickly (with the support of the labour union to which the seafarer belongs), but sometimes legal proceedings are necessary. Several representatives of labour unions also noted that, in some cases, **there may be a lack of trust in the medical personnel available on ships because they are employed by the cruise companies.**

In addition to the medical care on board, it is important to consider the social security protection available to seafarers. According to the MLC, social security provisions should be defined by the seafarers' country of residence. The evidence collected suggests that **access to social security varies**. While it is well-regulated for EU seafarers, it may not

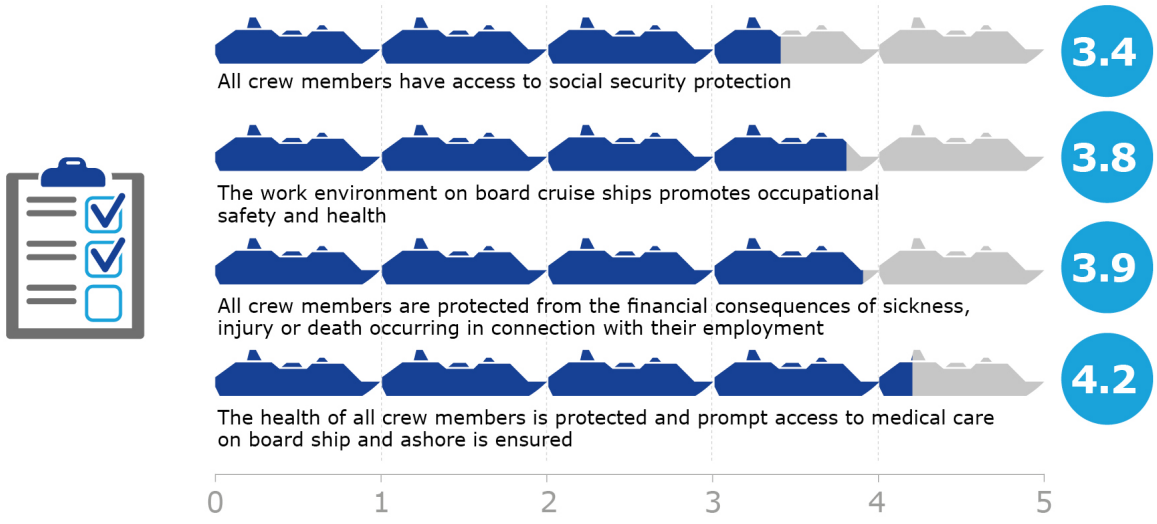
[214] https://www.itfseafarers.org/en/issues/women-seafarers
[215] Radic, A. (2019). Occupational and health safety on cruise ships: Dimensions of injuries among crew members. Australian Journal of Maritime & Ocean Affairs, 11(1), 51-60.
[216] Ibid.
[217] https://www.ilo.org/global/standards/maritime-labour-convention/lang--en/index.htm

be available to some non-EU seafarers due to the provisions in their home countries (*"Many of the seafarers' home countries don't have social security… In Indonesia, there is nothing. In India, they have a life insurance system" – Labour union representative).*

Access to pension schemes varies depending on the policies of each cruise company and the seniority of the seafarers *("Some companies have something where you can apply for a pension scheme for all positions, so at end of your career you have something." – Labour union representative; "Some career people have the option but must have been there for a period of time." – Member of academia).* Sometimes it is not available at all. Countries ratifying the MLC, 2006 must report to the ILO the social security protections that apply to seafarers at the moment of ratification. As such, Flag States could choose to take this information into consideration when certifying ships from these countries.

There was **a widespread view in the survey that the health of crew members is protected** and they have prompt access to medical care. The degree of consensus on work environment promoting occupational safety was also relatively weak compared to some other hypothesis. There was slightly more agreement on there being protection from the financial consequences of sickness, injury and death. The **likelihood of having social security protection**, with a score of 3.4 (Figure 35), **was the worst scoring of any hypothesis in the survey**.

Figure 35 Results of the scored survey (health protection, medical care & social security)



Source: Deloitte/Ramboll analysis

Box 9 Good practice in health and wellbeing

Examples of good practice
- Discussing situational awareness in daily short meetings and more in-depth at the beginning, mid-term, and end of contracts
- Rotating the crew and giving them extra time off when operational needs are not as high
- Creating new and challenging tasks and alternating the tasks, duties and shifts of seafarers to avoid complacency
- Hiring shoreside labour to assist cruise ship employees in dealing with luggage operations and in that way reduce the time pressure on cruise ship employees

7.4 The EU framework

While the MLC provides an international framework, the EU has supplemented this with regulation of its own, much of it based on MLC, 2006 (Table 8).

Table 8 EU regulatory framework[218]

Area	Legislation
Source international legislation: Maritime Labour Convention (MLC, 2006)	
Council Directive 2009/13/EC of 16 February 2009 implementing the Agreement concluded by the European Community Shipowners' Associations (ECSA) and the European Transport Workers' Federation (ETF) on the Maritime Labour Convention, 2006, and amending Directive 1999/63/EC[219]	
Directive 2013/54/EU of the European Parliament and of the Council of 20 November 2013 concerning certain flag State responsibilities for compliance with and enforcement of the Maritime Labour Convention, 2006[220]	
Minimum requirements	
Age limit	Council Directive 1999/63/EC of 21 June 1999 concerning the Agreement on the organisation of working time of seafarers concluded by the European Community Shipowners' Association (ECSA) and the Federation of Transport Workers' Unions in the European Union (FST)[221]
Medical fitness	Council Directive 1999/63/EC of 21 June 1999 concerning the Agreement on the organisation of working time of seafarers concluded by the European Community Shipowners' Association (ECSA) and the Federation of Transport Workers' Unions in the European Union (FST) [222]

[218] Some legislatives acts appear more than once because they cover more than one area
[219] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32009L0013
[220] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32013L0054
[221] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31999L0063
[222] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31999L0063

Area	Legislation
Training	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention) (1978)[223] (Member States were authorised to become party of the Convention with Council Decision 2015/799[224]
	Directive 2008/106/EC on the minimum level of training of seafarers[225]
Conditions of employment	
Hours of work and rest	Council Directive 1999/63/EC of 21 June 1999 concerning the Agreement on the organisation of working time of seafarers concluded by the European Community Shipowners' Association (ECSA) and the Federation of Transport Workers' Unions in the European Union (FST)
	Directive 1999/95/EC of the European Parliament and of the Council of 13 December 1999 concerning the enforcement of provisions in respect of seafarers' hours of work on board ships calling at Community ports[226]
Annual leave	Council Directive 1999/63/EC of 21 June 1999 concerning the Agreement on the organisation of working time of seafarers concluded by the European Community Shipowners' Association (ECSA) and the Federation of Transport Workers' Unions in the European Union (FST)[227]
Employee rights	Directive 2015/1794/EU amending five directives giving seafarers the same rights as employees on shore[228]
	Directive 2001/23/EC on safeguarding employees' rights in the event of transfers of undertakings, businesses or parts of undertakings or businesses[229]
	Directive 2008/94/EC on the protection of employees in the event of the insolvency of their employer[230]
Source international legislation: SOLAS International Convention for the Safety of Life at Sea (1974)[231] (ratified by EU Member States)	
Health and social security protection	
Health and safety	Directive 89/391/EEC on the introduction of measures to encourage improvements in the safety and health of workers at work[232]

[223] https://www.imo.org/en/OurWork/HumanElement/Pages/STCW-Convention.aspx
224 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015D0799
[225] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0106
[226] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A31999L0095
[227] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31999L0063
[228] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015L1794
[229] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32001L0023
[230] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32008L0094
[231] https://www.imo.org/en/KnowledgeCentre/ConferencesMeetings/Pages/SOLAS.aspx
[232] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A31989L0391

Area	Legislation
	Council Directive 92/29/EEC on minimum safety and health requirements for medical treatment on board vessels[233]
	Directive (EU) 2017/2108 on safety rules and standards for passenger ships[234]
Social security	Regulation (EC) No 883/2004 on the coordination of social security systems[235]
Inspections	
Directive 2013/38/EU on port State control[236]	
Directive 1999/95/EC on enforcement of provisions on seafarers' hours of work onboard ships[237]	
Directive (EU) 2017/2108 on safety rules and standards for passenger ships[238]	
Directive 2008/106/EC on the minimum level of training of seafarers[239]	
Council Directive 92/29/EEC on minimum safety and health requirements for medical treatment on board vessels[240]	

Source: Deloitte/Ramboll analysis

As noted in the introduction to this chapter, **the proposed Corporate Responsibility Directive[241]** will provide an overarching framework for all employers with employees in the EU, one that **will also have major implications for the cruise industry and its ecosystem**. As the introduction to that proposal notes: "*The behaviour of companies across all sectors of the economy is key to succeed in the Union's transition to a climate-neutral and green economy in line with the European Green Deal and in delivering on the UN Sustainable Development Goals… This requires implementing comprehensive mitigation processes for adverse human rights and environmental impacts…The connection of the EU economy to millions of workers around the world through global value chains comes with a responsibility to address adverse impacts on the rights of these workers.*"

7.5 Findings

Seafarers' experiences differ greatly depending on their roles and responsibilities on the ships, contract provisions, policies of the cruise company that employs them, and Port State legislation. However, **there is a high degree of consensus that most core requirements are being met.** The consensus is **highest around basic requirements, such as minimum conditions of employment and working conditions**; the consensus remains high, but with less overall conviction around issues ranging from food

[233] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31992L0029
[234] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32017L2108
[235] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A02004R0883-20140101
[236] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013L0038&from=EN
[237] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A31999L0095
[238] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32017L2108
[239] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0106
[240] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31992L0029
[241] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022PC0071

to shore leave, contract terms and the availability of social security. Interviews and the literature throw up a range of issues not covered by regulation ranging from abusive practices by placement companies (though cruise lines have safeguards in place to avoid it in their recruitment) to access to the internet as a contributor to mental health.

CHAPTER 8: CRUISE TOURISM: PORTS – CHALLENGES AND RESPONSES

8.1 Introduction

As already pointed out, the cruise tourism industry is not just about cruise ships. And while destinations are about more than ports as pointed out in the next chapter, ports are a critical interface with cruise ships. Cruise operators and port operators have to take long-term infrastructure decisions that mesh with each other. Thus ports are on the frontline in supporting and promoting the sustainability of the industry. This chapter addresses some **implications of the environmental challenges for port authorities' infrastructure, how they are responding with infrastructure and onshore installations,**[242] and how they are driving sustainability by providing environmentally friendly infrastructure and promoting the circular economy.

8.2 The interface between cruise ships and ports

Cruise ships have infrastructure implications for European ports primarily in the following areas:

- port reception facilities (PRF) and the monitoring of cruise lines' waste deliveries;
- onshore power supply (OPS), including installation of compatible OPS installations onboard;
- alternative fuel bunkering facilities (such as LNG) and corresponding installations onboard vessels;
- air emissions monitoring equipment.

The most common challenges experienced by port authorities in the provision of the infrastructure installations are first and foremost **investment and certainty about the demand from shipping** (particularly for the installation of OPS) followed by what was described by port authorities and technology developer Wärtsilä in research for this study as **'inadequate legislative clarity' on safety requirements** and guidelines for **bunkering new fuels**.

Additional obstacles relate to **port size.** Smaller ports experience added challenges in finding space for installation of e.g. LNG fuel bunkering facilities or OPS. Grid capacity and the absence of standardisation of OPS onboard vessels are other key hurdles. A representative of ESPO stated, for example, that: *"There is no business case for OPS. There's always a cost gap that needs to be filled by public funding. There is a 5 billion euro budget shortfall in EU Ports before the Green Deal that will be higher now. No OPS has been supplied […] without public funds."* Coordination and co-financing by cruise lines are also crucial to the deployment of alternative fuel infrastructure.

Nevertheless, a number of European ports do provide OPS installations. EMSA's European Maritime Transport Environmental Report (2021)[243] provides data on the European port installation of LNG bunkering and OPS facilities. Germany, Norway, Spain, and the Netherlands have the greatest number of LNG bunkering facilities installed at ports. 30 ports have OPS installations, but only five ports have OPS installations for cruise ships. In all but the case of Bergen, which has three, there is only one OPS connection.[244] According

[242] The capital cost of infrastructure upgrades is not considered in this study since we focus on practical best practices and future performance. The phasing and funding of the changes should then be considered by all the relevant stakeholders on a case-by-case basis.
[243] https://www.eea.europa.eu/publications/maritime-transport/
[244] https://www.eafo.eu/shipping-transport/port-infrastructure/ops/data

to the CLIA, there are, however, plans to install OPS in another 18 berths in Europe by the middle of the decade.

8.3 Ports as drivers of cruise industry sustainability

Ports are also taking other initiatives to encourage ships docking at their berth to follow environmentally sustainable practices. **Port fees** make up a small part of the total port costs for ships and an even smaller part of the total cost of a ship's journey. As such, they may not significantly change shipowners' investment decisions. Nonetheless, port incentive schemes are considered a useful instrument to reward frontrunners and assist ports in pushing their environmental priorities. In recognition of this, European ports are introducing differentiated environmental port charges where it makes sense) as part of their own strategy.

The EcoPorts network Environmental Report 2021 shows that over half the surveyed ports use differentiated port fees to incentivise 'green' vessels. Of these, 50% of surveyed ports specifically incentivise waste management and segregation, 65% incentivise air emission reductions (NOx, SOx, PM), 46% incentivise GHG emission reductions, 23% incentivise noise reductions, and 54% incentivise vessels with an environmental certification.[245] EcoPorts monitors onshore power deployment in ports, including their technical specifications; the European Alternative Fuels Observatory (EAFO) also monitors LNG (liquefied national gas) and OPS deployment in the EU[246]. However, monitoring is not widespread, and there is a lack of guidance for the installation of OPS onboard vessels, including cruise ships.

Some port authorities choose to provide additional rebates for vessels certified, for instance, with the Green Award[247] or the Blue Angel ecolabel. Research for this study found that other port authorities provide **incentives based on behaviours**, such as vessels discharging separated waste, or vessels that deliver sewage. The port of Helsinki, for instance, provides a 20% discount on the waste management fee charged for solid and oily ship-generated waste discharged at port, and some Norwegian ports have NOx-based shipping lane fees where lower emissions lead to fee reductions.

Box 10 Question marks about the usefulness of port incentives

In research for this study, a representative of HELCOM noted that **the effectiveness of economic incentives may depend on the legal status of the port, as a private port** may have fewer incentives to provide economic discounts unless there are specific national policy aims to comply with. Nevertheless, **two cruise operators interviewed** noted that **incentives at ports are making a difference** in reducing environmental pressures. TUI Cruises noted, for instance, that *"The indexes come from overall pressure to do something about air pollution without needing to wait for governmental and regulatory pressure. As a company, the simplest way of getting the company to invest in better technologies is getting an operational reward."* Other stakeholders were less enthusiastic about port rebates for sustainable behaviour. Cruise Baltic stated that they experience cruise line awareness of rebates, such as the Environmental Ports Index of the Environmental Ships Index, to be low as the financial benefits are not high enough for many cruise lines to be interested in making significant changes to meet them.

[245] https://www.ecoports.com/publications/environmental-report-2021
[246] https://alternative-fuels-observatory.ec.europa.eu/
[247] https://www.greenaward.org/sea-shipping/certificate-holders-ships/

ESPO's Good Green Practices 2021[248] highlights examples of how ports are increasingly engaging in the **provision of bunkering for alternative fuels**, installing renewable power solutions, upgrading efficiency measures, and monitoring localised air emissions.

Table 9 below provides an overview of some of the good port practices highlighted in research for this study.

Table 9 Examples of infrastructure developments at European ports

Examples
Port of Amsterdam is placing a methanol fuel production plant near/at the port that produces methanol from non-recyclable waste. The plant will produce around 87.5 kilotons per annum of renewable methanol each year, which amounts to the waste produced by 290,000 households. This renewable methanol, which is an alternative to methanol produced from fossil fuels, will contribute to reducing carbon emissions.
Port of Amsterdam is experimenting with batteries to charge larger vessels at berth. In this case, a battery has been fuelled with local wind energy to charge a short sea vessel at one of its terminals. This supplies 630kWh which is 12 hours of shore power.
Port of Antwerp is using waste heat from a waste incineration facility and connecting it for district heating.
Port of Bergen is running a battery-run workboat. Operating silently and running completely emission-free, the boat is able to work in the inner harbour and along the quays on batteries only. The new vessel will handle a variety of tasks: maintenance of port installations, towing of boats, personnel transport, rescue missions, as well as the possibility of assisting in oil spill operations.
Port of Bilbao is installing a green hydrogen production plant. This will be operational in 2024. The green hydrogen produced will be used as a raw material to generate synthetic fuels for use in different means of transport.
Port of Gothenburg is partnering with Volvo Group, Scania and Stena Lina to cut carbon emissions generated from transport to and from the port by 70% by 2030. This will include the installation and provision of access to green fuels for heavy vehicles, such as hydrotreated vegetable oil (HVO), biogas, and hydrogen gas.
Port of Hamburg was the first port to provide an OPS facility in 2016. By the end of 2025, it is planning to provide OPS at all cruise berths.
Helsinki Port is applying auto mooring systems to make port operations faster and more sustainable.
Port of Kiel is installing an additional OPS facility which will supply cruise ships berthing at Kiel's Ootsuka with shore power of up to 16MVA at either 6.6 or 11 kV. The Port only uses 100% green power when supplying its customers with shore power.
Port of Ostend is testing the feasibility of hydrogen bunkering and use at ports as an innovation lab for new fuels and technologies, e.g. the ISHY (implementation of hybrid shipping) project[249]

[248] https://www.espo.be/practices
[249] https://ishy.eu/about-ishy/dd

Examples
Port of Piombino is redesigning its maintenance and service projects to increase the energy efficiency of its plants. This, for example, includes all public lighting systems under the port's jurisdiction being replaced with LED, and outdoor walkway roof replacements with PVC to ensure clean energy for buildings' needs.
Port of Rotterdam has signed a memorandum of understanding with Horisont Energi to create a corridor to transport blue ammonia (i.e. ammonia produced from gas but with carbon capture and storage) produced in northern Norway to the Port of Rotterdam, from where it can be distributed in northwest Europe.
In the **Port of Rotterdam**, a 200MW electrolyser will be constructed on the Tweede Maasvlakte and will produce up to 60,000 kilograms of renewable hydrogen per day starting from 2025. The renewable power for the electrolyser will come from the offshore wind farm Hollandse Kust (Noord).
Port of Segundo Valencia is installing booths to monitor air quality and other environmental impacts in real time, SO2, NO2, O3, CO, and PM10 and PM2.5.
Port of Tallinn has opened a new cruise terminal that is powered by solar panels and heated through sea power using a heat pump.

Source: Deloitte/Ramboll analysis

8.4 The ports' role in the circular economy

European ports are more and more becoming viewed as **circular economy innovation hubs due to the logistical capacity** for connecting locations with supplies and delivering/processing sources to sea-going vessels. EMSA's European Maritime Transport Environmental Report (2021)[250] describes multiple opportunities and examples of how ports are engaging in circular economy initiatives. Other port and cruise operator sources confirmed this during the research for this study. Such initiatives include the development of **specialised recycling or remanufacturing facilities, and the use of sludge and oily bilge water discharge in the development of biogas or reuse.**

However, EMSA has found that **national circular economy initiatives are not always adapted to the type of port and its capacity** to develop circular economy strategies. Consequently, EMSA suggests that ports individually assess how they can best engage given their size, legal status, and capacity. Box 1 Upstream and downstream challenges. Box 11describes the recommended areas of engagement recommended by EMSA.

[250] https://www.eea.europa.eu/publications/maritime-transport/

Box 11 EMSA recommendations on circular economy priorities for ports

Circular assets and equipment — optimising capacity and extending the lifetime of port assets and infrastructure, such as buildings, cranes, quays and buoys, through maintenance and smarter use (sharing, renting, etc.), including green procurement

Circular flows within ports and between ports and surrounding areas — new uses for would-be waste generated by port activities, such as ship waste and by-products of industries operating within ports, and port development activities (recycling, upcycling, cascading, etc.);

Ports and circular markets — ports enabling other industries (both on- and offshore) to become more circular by developing new activities that connect the supply of and demand for circular resources as the material moves through the port.

The report further provides examples from existing port initiatives. It for instance notes that the **Port of HaminaKotka** (Finland) is using a 3D operating system that has allowed for more effective maintenance and repair of port facilities, while the **Port of Frederikshavn** (Denmark) has developed a quay to decommission ships and rigs in a way that repurposes 100% of both the machinery and the materials.

It is additionally suggested that oily waste collected by port reception facilities could be processed via filtration, centrifugation, dewatering, flocculation, or distillation reuse. Other port authorities are delivering sludge discharge from cruise vessels to wastewater treatment plants for the development of biofuels. These initiatives alongside the European Commission's Circular Economy Action Plan[251] suggest that additional infrastructure developments and circular economy procedures at ports will be applied and required more frequently in future.

While the onshore waste processing facilities have to be ready for circularity, **cruise ships will need to play their part in enabling circularity through sorting and other sustainable practices** (such as reducing the use of single-use plastics) while at sea. Cruise ships can be stimulated to be circular by imposing requirements on the delivery of waste-to-waste processing facilities (e.g. all waste separated) and encouraging the top-performing cruise ships to circularity with certification (e.g. Blue Angel[252], and Green Marine[253]). Ports can also encourage separated delivery of waste by providing financial incentives. Examples of ports that adopt this approach are the Port of Stockholm and the Port of Tallinn.

8.5 Findings

Port infrastructure is a critical enabler for the sustainability of the cruise industry. In some cases, provision of this infrastructure is driven by the regulatory requirements described in Chapter 10 or by the expectation of regulation to come, e.g. on the use of LNG or Onshore Power supplies. **Ports are also driving sustainability** with incentives to good green practice through port fee abatement, environmentally friendly investments or practice which go beyond regulatory requirements, and innovation in the circular economy. They face challenges in infrastructure decision-making, however, from lack of regulatory certainty and high capital costs.

[251] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN
[252] https://www.blauer-engel.de/en
[253] https://green-marine.org/certification/

CHAPTER 9: THE CRUISE ECOSYSTEM - DESTINATION IMPACTS AND RESPONSES

9.1 Introduction

Chapter 1 provided an introduction to the cruise tourism ecosystem, illustrating how many different players need to be taken into account. Chapter 3 provided insights into voyage patterns by destination. Chapter 4 underscored the economic impact of the industry. This chapter combines consideration of the destinations with the economic impact by key destination to illustrate how significant the impact can be and also how variable it can be depending on the extent to which the destination depends on cruise tourism. It then assesses the extent to which destinations are rising to the environmental and social challenges based on case studies that were carried out of 13 destinations. Of these destinations, 12 are in the EU[254] and include a range of destination types, from those heavily dependent on cruise tourism to those which are primarily general cargo ports which are also visited by cruise ships. The thirteenth is Miami, the world's leading cruise port.

9.2 Calculating the destination-level impact

The Tables below provide a summary of the direct, indirect and induced impacts for these 13 selected destinations for 2019 (the last pre-COVID19 year). To compute the destination-level impacts, national input-output tables were used to calculate the indirect and induced impact multipliers. In cases when data was not available for 2019, earlier data was used corrected for inflation. Table 10 shows the total impacts for each destination and Table 11 shows the impact per passenger. As in the case of the economic impact calculations in Chapter 4, the total is the sum of direct spending, indirect and direct impacts. Added value is provided for information.

In absolute terms Miami feels the greatest economic impact, followed by Sint Maarten, the Balearics, Marseille and Stockholm. The Balearics account for almost one quarter of the economic impact of tourism in the EU. Destinations within the Mediterranean draw larger (cruise) tourist numbers (Figure 17) and therefore depend on the cruise sector for jobs and to generate economic impact.

However, **a closer look helps to compare the destinations not only on the aggregate impact but additionally sheds light on the different models of cruise tourism**. For instance, for a destination such as Stockholm on the Baltic Sea, cruise tourism generated an economic impact of EUR 180 million in 2019 with 281 port calls and 650 000 passengers. In comparison, the economic impact of cruise tourism in Marseille was EUR 269 million for 500 port calls and 1.8 million passengers, an impact 50% higher for almost twice as many port calls as Stockholm and almost three times the number of passengers.

[254] Including one, Sint Maarten, from the group of Associated Overseas Countries and Territories. Sint Maarten is part of an island which also includes the French overseas département of Saint Martin. Both have cruise ports but only Galisbay on Sint Maarten can accommodate the large cruise ships.

Table 10 Economic impacts at case study destinations (EUR million, 2019)

	Balearic Islands	Bergen	Constanța	Copenhagen	Cork	Hamburg	Lisbon	Marseille	Miami	Sint Maarten	Stockholm	Tallinn	Valletta
Direct spending	254.8	38.8	0.7	111.3	17.6	96.5	41.3	106.4	604.3	388.3	95.1	64.3	69.4
Direct value added	*117.5*	*15.5*	*0.3*	*45.2*	*9.3*	*41.3*	*33.9*	*58.7*	*318.0*	*175.9*	*32.1*	*25.4*	29.8
Indirect effect	95.0	11.1	0.3	24.4	7.7	33.3	21.3	31.9	275.4	80.0	23.4	24.3	24.7
Induced effect	118.8	22.4	0.7	24.5	14.9	17.7	44.5	130.5	5.6	109.6	61.0	41.8	41.9
Total economic impact	**468.6**	**72.3**	**1.7**	**160.2**	**40.2**	**147.5**	**107.1**	**268.8**	**885.3**	**577.9**	**179.5**	**130.4**	**136.0**

Source: Deloitte/Ramboll Analysis

Table 11 Economic impact at case study destinations per cruise passenger (EUR), 2019

	Balearic Islands	Bergen	Constanța	Copenhagen	Cork	Hamburg	Lisbon	Marseille	Miami	Sint Maarten	Stockholm	Tallinn	Valletta
Cruise passengers ('000)	2 200	576	10	940	100	810	571	1 800	6 800	1 600	650	656	902
Per pax economic impact (EUR)	213	126	170	170	402	182	188	149	130	361	276	199	151

Source: Deloitte/Ramboll analysis

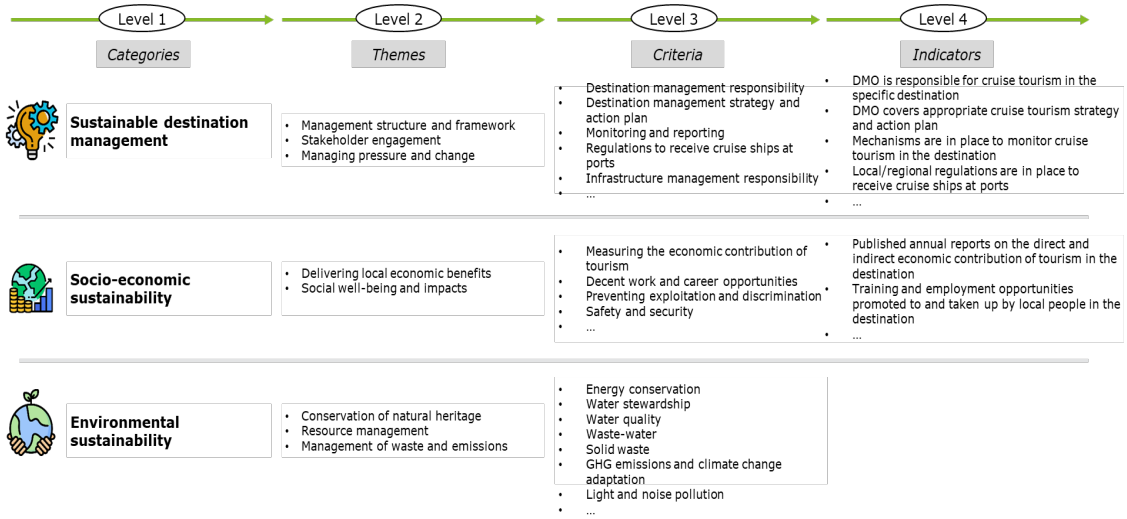
This indicates that a model which leads to passengers spending at the destination (which Table 11 shows the case on a per tourism basis more in Stockholm than in Marseille) is crucial to impacts on local communities. With ambitions to attract more cruise tourist passengers in the future (in 2019 there were 10 000 cruise passengers), the port and city of Constanța have invested in cruise port infrastructure. The economic impact of the cruise tourism industry in 2019 in Constanța stood at EUR 1.4 million, but the impact per passenger outstripped many more popular destinations. Cork, with 100 000 passengers is generating by far the greatest economic impact per passenger at EUR 402, more than twice that of any other destinations except Stockholm, and 46% more than Stockholm.

Destinations such as Bergen are exploring ways to leverage such insights and create tourism segments that focus on the quality of tourism through a lower number of tourists and higher-value activities.[255] This will help manage the risk of over-tourism without compromising the resulting economic impact of cruise tourism on the destination.[256]

9.3 Managing the impacts of tourism

Like the industry itself, destinations need to be resilient and to be adopting responses to today's challenges that are future-proof. The extent to which key destinations are rising to these challenges was assessed using the GSTC Destination Criteria (GSTC-D)[257] of the Global Sustainable Tourism Council (GSTC) (Figure 36). This framework takes into account a range of guidelines and standards for sustainable tourism (e.g. UNWTO, World Travel and Tourism Council – WTTC) from every continent. This **adds the dimension of destination management** to criteria on environmental and social challenges, such as those explained in Chapters 4-6.

Figure 36 Selected GSTC Destination Criteria



Source: Global Sustainable Tourism Council (GSTC)

[255] Interview insights with DMMO of Bergen, more detail in individual destination fiche of Bergen
[256] This is an area the EU is addressing, see *Unbalanced tourism growth at destination level* - https://op.europa.eu/en/publication-detail/-/publication/816f1561-3a32-11ed-9c68-01aa75ed71a1/language-en/format-PDF/source-268441400v
[257] https://www.gstcouncil.org/gstc-criteria/gstc-destination-criteria/

Box 12 The GSTC Destination Criteria Framework in practice

The GSTC Destination Criteria framework has already been field-tested around the world. In Dubrovnik, for example, GSTC conducted a CLIA-financed destination assessment, including on-site activities, in the last months of 2019 and worked with the Dubrovnik Tourist Board and the Dubrovnik Development Agency together on their project to develop sustainable tourism. **The results of the assessment identified key gaps and actions needed to help move tourism in Dubrovnik towards a sustainable future**[258].

This study, which required a partnership between the cruise industry and the city of Dubrovnik, was a testament to what can be achieved through collaborative tourism initiatives to help preserve the heritage and environment of the world's favourite destinations for future generations. Furthermore, the GSTC, in partnership with the CLIA, has also used this framework to assess destinations in Greece (Athens, Corfu, Heraklion)[259].

Destination management, according to the UNWTO, is the coordinated management of attractions, amenities, access, marketing and pricing. It is normally in the hand of Destination Management Organisations (DMO's). Destination management takes a strategic approach to linking the separate elements for better management of the destination and avoid overlap and duplication of effort in promotion, visitor services, training and business support, and identify management gaps. Destination management calls for coalition and collaboration of *many organisations and interests* working towards a common goal, ultimately assuring the competitiveness and sustainability of the tourism destination.

In the past few years, there has been increasing recognition of the need for planned tourism management. Tourism management includes imposing regulations such as limiting the number of cruise calls and/or passenger numbers as the phenomenon over over-tourism has increased in tourism as a whole. Moreover, according to the WTO[260], **new trends and paradigms, including digital transformation, emerging 'disruptors', such as new platform tourism services** (e.g. in the accommodation sector) **or visitor growth management, have created a pressing need for many destination management organisations (DMOs) to enlarge their scope to become all-embracing DMMOs** (Destination Management and Marketing Organisations).

In the complex global scenario that exists today, the DMMO has become the fulcrum of all development activities of a destination.[261] There is a shift towards recognising that **the role of the DMMO goes well beyond marketing** to include other activities that are also critical to the success of tourism in a destination from a competitive and sustainable perspective.[262] Maintaining a positive image of the destination is a responsibility of the DMMO as well as managing situations that may arise with a negative impact on the image due to any crisis (e.g. COVID-19).

The DMMO's leads and coordinates activities as part of a coherent strategy in pursuit of a common goal, but this requires the sign-off from multiple stakeholders (e.g. policymakers, national or regional tourism bodies, etc.) Typically, this strategy is contained in a destination management plan. Destination management plans are essential to ensure tourism is economically, socially and environmentally beneficial to all tourism stakeholders. This means optimising the benefits that tourism brings to a

[258] https://www.gstcouncil.org/report-on-gstc-destination-assessment-of-dubrovnik/
[259] https://news.gtp.gr/2021/01/20/clia-gstc-pave-way-sustainable-cruise-tourism-development-greece/
[260] https://www.e-unwto.org/doi/epdf/10.18111/9789284420841
[261] Role of Destination Management Organization in Tourism Crisis Management: A Middle Eastern Perspective
[262] Presenza, A; Sheehan, L; Ritchie, B. (2005) Towards a model of the roles and activities of destination management organizations: Journal of Hospitality, Tourism and Leisure Science. Electronic Copy

destination while minimising its negative impact and achieving a sustainable balance between the interests of visitors, residents, businesses, and natural environments. The challenges for destination management are manifold, ranging from visitor flow management to infrastructure capacity, pollution, waste management, and water and energy consumption in a complex ecosystem.

The ideal scenario would involve all stakeholders to a certain extent in developing the destination. However, cruise tourism is an inherently supra-national tourism product, as many cruises visit more than one city and/or country. Therefore, **the responsibility lies with the national organisations (or DMOs) and the cruise lines to promote and engage in regional dialogues**, working in close collaboration among geographically close destinations and countries. Some initiatives and collaborations exist with (a part of) these stakeholders, for example the round-table discussions that are held in the Port of Amsterdam, the so-called Doughnut Model. The model describes how societies and businesses can contribute to economic development while still respecting the limits of the planet and society[263].

For the destination assessment of performance in sustainable destination management, socio-economic sustainability and environmental sustainability in the 13 case studies selected for this study, the consortium developed **a dedicated Destination Assessment Framework on the cruise tourism sector** based on a sub-set of the GSTC Destination Criteria Framework V2[264]. In general, the framework developed by the GSTC applies to tourism as a whole; the consortium aimed to make cruise tourism the focal point.

Table 12 shows the specific criteria used. Table 13 shows the result of applying the detailed sub-set of criteria to the case study destinations. A mark between 0.00-0.99 implies 'risk', 1.00 to 1.45 means 'moderate risk', 1.50-1.99 indicates 'needs improvement', 2.00-2.49 is 'good', 2.50-3.00 is 'excellent'. As can be seen from Table 13, **the picture across the case study destinations is extremely mixed**, ranging from Sint Maarten, where all three scores are in the 'risk' category and Stockholm, which has one 'good' and two 'excellent' score. These destinations generally score higher on socio-economic aspects than on environmental sustainability (Constanța and Cork are exceptions, and the scores are the same for the Balearics and Bergen). They also score higher socio-economic aspects than destination management (Bergen and Sint Maarten are exceptions, while the scores are the same for Cork.) Seven score more highly one environmental sustainability than destination management and six score more highly on destination management than environmental sustainability. Scandinavian destinations perform better than Mediterranean destinations. The fact that there are only three scores in total in the 'excellent' category tells its own tale. (The detailed data is Appendix 2.)

Table 12 Criteria used to assess destination management, environmental sustainability and socio-economic benefits.

[263] https://www.amsterdam.nl/en/policy/sustainability/circular-economy/
[264] https://www.gstcouncil.org/gstc-criteria/gstc-destination-criteria/

Destination Management	Environmental Sustainability	Socio-economic benefits
Destination management responsibility Destination strategy & action plan Monitoring and reporting Regulation to receive cruise ships Infrastructure management responsibility Sustainability awareness of the above Engagement with other bodies Enterprise engagement & sustainability standards Resident engagement and feedback Visitor engagement and feedback Promotion and information Managing visitor volumes & activities Planning regulations & development control Climate change adaptation Risk and crisis management Public Health issues	Protection of sensitive environments Visitor management at natural sites Wildlife interaction Species exploitation & animal welfare Energy conservation Water stewardship Water quality Wastewater Solid waste GHG emissions & climate change mitigation Low-impact transportation Light and noise pollution	Measuring the economic contribution Decent work and career opportunities Preventing exploitation & discrimination

Source: Deloitte/Ramboll analysis

Table 13 Case study destinations' performance against GTSC criteria

Destination	Destination Management	Environmental Sustainability	Socio-economic benefits
Balearics	0.8	1.3	1.3
Bergen	2.5	2.0	2.0
Constanța	0.9	1.7	1.4
Copenhagen	1.9	2.2	2.7
Cork (Cobh)	2.0	2.1	2.0
Hamburg	1.9	1.3	2.2
Lisbon	1.4	1.1	1.6
Marseille	1.6	1.3	2.3
Miami	2.0	2.2	2.8
Sint Maarten	0.7	0.3	0.5
Stockholm	2.4	2.7	3.0
Tallinn	1.5	1.5	1.6
Valletta	1.4	1.8	2.7

Source: Deloitte/Ramboll analysis

Despite Stockholm's overall strength, an accompanying analysis of strengths and weaknesses pinpointed the need for Stockholm to involve the local community more. **Involving the local communities or involving a broader group of stakeholders were a widely identified weakness**. Another recurring weakness was the **absence of monitoring and reporting systems** and of **plans to manage visitor flows** in general or cruise tourism flows in particular. Investing in green technologies is an opportunity for a number of destinations.

Box 13 EU initiatives to promote good destination management

The EU itself has launched several initiatives at the destination level: the ***European Capitals of Smart Tourism*** **initiative recognises outstanding achievements by European cities as tourism destinations** in four categories: sustainability, accessibility, digitalisation as well as cultural heritage and creativity[265]. This EU initiative aims to network and strengthen destinations, as well as to facilitate the exchange of good practices, and ultimately, promote smart tourism in the EU.

Gothenburg and Málaga were jointly the 2020 European Capitals of Smart Tourism, while Helsinki and Lyon won the inaugural competition and jointly held the titles of 2019 European Capitals of Smart Tourism. Bordeaux and Valencia were the 2022 Capitals of Smart Tourism.

Gothenburg stood out for its digital offering that helps to improve experiences for both citizens and tourists. This has paved the way for abundant 4G coverage, smart grids for traffic and electricity, accessible and open government data and future-oriented public transport systems. All these initiatives optimised citizens' lives and contributed towards environmental protection[266]. An additional sustainability angle was that the city was a pioneer in issuing green bonds and was one of the first places to set consumption-based emission targets. It also launched a new website aimed at gathering innovative and sustainable ideas to improve the tourism experience in cities around the world[267].

[265] https://smart-tourism-capital.ec.europa.eu/index_en
[266] https://smart-tourism-capital.ec.europa.eu/cities/competition-winners-2020/gothenburg/gothenburg-2020-eutourismcapital_en
[267] https://www.101sustainableideas.com/

In Málaga, sustainability was transversal – it had installed public LED lighting, offered over 20 bike hire stations and created bike lanes that added up to over 40km. The city had installed smart watering systems for parks and gardens in order to save water and had introduced an Air Quality Sectoral Plan to reduce air pollution, monitor pollen levels and improve noise quality. Málaga had also upgraded street cleaning equipment and worked on better waste separation in the city centre.

Both Gothenburg and Málaga had in common the constant exchange of information between visitors and the government's tourism services so that the municipality and the tourism industry could do more to meet the needs of visitors. The cities listened to their visitors, as well as their citizens. The entire tourism ecosystem could thus reap the benefits of the improvement initiatives.

A more recent example from April 2021 was the launch by the European Commission of the *European Destination of Excellence* (EDEN) 2022. This initiative rewards the best achievements in sustainable tourism and green transition practices in smaller destinations across Europe. EDEN was first introduced by the European Commission in 2007 as an initiative to reward non-traditional, emerging sustainable tourism destinations in Europe based on national competitions. The initiative has since then been redesigned and updated in light of the European Green Deal targets and will contribute to the recovery and resilience of tourism destinations impacted by the COVID-19 pandemic[268]. The winning destination will be positioned as a tourism sustainability pioneer committed to the European Green Deal objectives and will receive expert communication and branding support at the EU level throughout 2022. Middelfart was the initial winner.

The exemplary cities mentioned above have showcased how the collaboration between public and private sectors can build the reputation of a destination, simultaneously solving some of these challenges. Ultimately, with the launch of different regional initiatives on this topic, sharing good practices amongst destinations with similar characteristics will help achieve wider EU objectives.

9.4 Findings

The economic impact of cruise tourism at a given destination depends not only on whether the destination is attractive to cruisers, but also on the business model. Some destinations are generating a much higher economic impact per passenger than others, which suggests that those destinations may have found a model which puts less pressure on their resources. All face destination, environmental and social challenges, even if those vary depending on destination specifics. However, but they are not all rising to those challenges successfully. Stockholm stands out as best-in-class, but even they could do more to involve local communities. Taking a holistic approach to destination management which involved all stakeholders was a common weakness across the 13 case study destinations.

[268] https://www.prnewswire.com/news-releases/new-european-destination-of-excellence-2022-competition-launched-301274861.html

CHAPTER 10: THE CRUISE ECOSYSTEM: REGULATORY AND NON-REGULATORY FRAMEWORKS

10.1 Introduction

The actors in the cruise ecosystem do not take strategic and investment decisions in a vacuum, but in the context of a range not only of existing but also of future regulatory and non-regulatory measures, particularly those of the European Green Deal[269] (and the Fit-for-55 policy package) and the Paris Agreement[270] on greenhouse gas reduction. This chapter sums up that context as a tool for understanding where regulation already impacts or will in future impact the environmental challenges identified in Chapter 6, the port challenges addressed in Chapter 8 and implicitly as well the destination management challenges discussed in Chapter 9. This chapter also discusses gaps in existing regulatory and non-regulatory frameworks. The information in this chapter provides additional backdrop to the drivers and constraints of the Good Practices identified in Chapter 11.

10.2 Regulatory overview

Regulatory measures are influenced by a wide range of frameworks developed by a number of governing bodies. These include:

- The **International Maritime Organization (IMO)**, notably the International Convention for the Prevention of Pollution from Ships (MARPOL)[271], as well as inter alia the **International Convention on the Control of Harmful Anti-fouling Systems in Ships**, the **Convention for the Safety of Life at Sea (SOLAS) and the Ballast Water Management Convention[272];**

- **Regional agreements** developed under **international conventions**, such as the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area (1992) which set up the Helsinki Commission (HELCOM)[273], an intergovernmental organisation that supplements IMO laws or develops new actions such as the Baltic Sea Action Plan[274] (which was updated in October 2021). This may include requirements for specific standards for wastewater treatment and emissions reductions. In total, there are four European regional sea convention treaties (Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention)[275], Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention)[276] for the North-East Atlantic, HELCOM, and the Convention on the Protection of the Black Sea Against Pollution (Bucharest Convention) that include sustainable development as part of their guiding principles while ensuring coverage of EU sea regions. Globally, 15 regional seas convention treaties are in place.

- **European Union** which sets regulatory requirements that either bind EU Member States directly (Regulations) or must be transposed into national legislation (Directives). These flow from initiatives such as the Green Deal, the Fit-for-55

[269] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[270] https://unfccc.int/sites/default/files/english_paris_agreement.pdf
[271] https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx#:~:text=The%20International%20Convention%20for%20the,2%20November%201973%20at%20IMO.
[272] https://www.imo.org/en/About/Conventions/Pages/International-Convention-on-the-Control-of-Harmful-Anti-fouling-Systems-on-Ships-(AFS).aspx
[273] https://helcom.fi/about-us/convention/
[274] https://helcom.fi/baltic-sea-action-plan/
[275] https://www.unep.org/unepmap/who-we-are/barcelona-convention-and-protocols
[276] https://www.ospar.org/convention

Packages, and Action Plans, such as the European Commission Zero Pollution Action Plan[277] adopted in May 2021.

- **National and local governments** may develop additional regulatory measures that may influence the reception of cruise ships at ports. An example includes 'The Government's action plan for green shipping'[278] in Norway, which sets a requirement that cruise ships and ferries must be emissions-free by 2026 if they want to operate in the West Norwegian Fjords World Heritage Site;

- **Classification societies** and their rules and regulations for operation (less relevant for measures that address receiving ships at port).

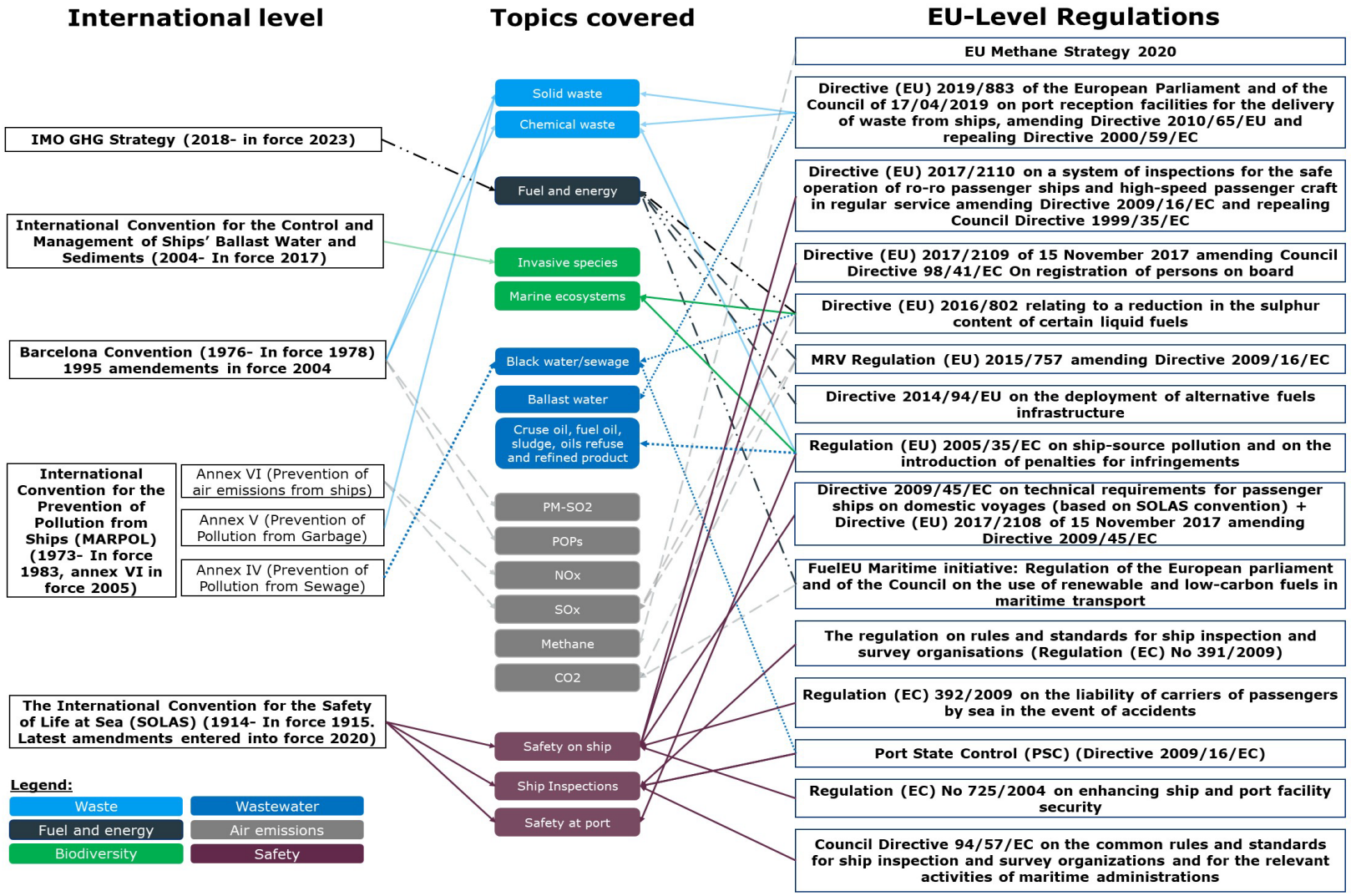
This is a complex and challenging landscape with measures that are not always aligned. The challenges include the:

- transboundary environmental impact of the industry;
- seasonal nature of cruises;
- sheer size/number of passengers/impact on (small) port operations;
- differing legal status of port authorities (they can for instance be private, municipal, or a hybrid).

Figure 37 below illustrates some of the main international and EU regulations that cover air and water pollutants alongside greenhouse gas emissions, waste, energy, fuel, biodiversity protection measures, and safety. While few regulatory measures are solely aimed at the reception of cruise operators at ports directly, segments of numerous legislative documents do have significant impacts on cruise operations while in port. The list here is not exhaustive but covers the main areas of regulation. Other regulation with some relevance for the reception of ships at port includes the conventions mentioned above (Bucharest Convention, HELCOM, OSPAR) and the Marine Strategy Framework Directive[279] among others.

[277] https://ec.europa.eu/environment/strategy/zero-pollution-action-plan_en
[278] https://www.regjeringen.no/contentassets/2ccd2f4e14d44bc88c93ac4effe78b2f/the-governments-action-plan-for-green-shipping.pdf
[279] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0056 and https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32017L0845

Figure 37 Overview of main international & EU regulatory frameworks affecting cruise tourism industry



The overview above highlights the extent to which air emissions (SOx, NOx, and particulate matter (PM)), wastewater, waste, and safety are regulated. It also highlights how, since the middle of the last decade more regulatory frameworks have been introduced to facilitate the decarbonisation agenda. This includes, among others, the IMO's GHG Reduction Strategy[280] (2018), the IMO's Data Collection System (DCS), the EU Regulation on the Monitoring, Reporting and Verification of Carbon Dioxide Emissions from maritime transport (MRV Regulation)[281], and the 'Fit-for-55' policy package[282] [283], which includes the extension of the ETS (Emissions Trading System) to maritime transport[284], the FuelEU Maritime initiative[285], the proposal for a revision of the Alternative Fuels Infrastructure Directive[286] and the proposal for the revision of the Energy Taxation Directive[287].

The regulatory frameworks include requirements for the provision and use of onshore power supply (OPS) and alternative fuels to facilitate the transition to net-zero carbon emissions as well as the reduction of air pollution and underwater noise. The impacts of these regulatory measures for receiving ships at ports are that **the installation of OPS will be required at berths in ports and that cruise operators may be required to install onboard installations and connect to OPS**. They will also require additional standardisation onboard vessels specifying cable management systems, use of frequency converters, and placement areas of OPS installations on the vessel. These measures may additionally prompt bunkering of new fuel types, thus requiring the retrofitting of many vessel engines, altering port supply chains and requiring new cruise and port staff expected competencies and changes in safety/security procedures.

The implementation of the EU's PRF (Port Reception Facilities) Directive[288] provides for mandatory rebates on the indirect waste fee for vessels that demonstrably reduce waste and engage in sustainable waste management onboard.

The overview in Figure 37 additionally illustrates how **international regulatory measures may be further defined or in some cases transcribed in EU legislation**. This was, for example, the case with the amendment to MARPOL Annex VI to reduce sulphur emissions by regulating the maximum sulphur content in marine fuel (0.50%), also known as the Global Sulphur Cap[289]. From 1 January 2025, cruise ships sailing in the Mediterranean Sea are obliged to use marine fuels containing a maximum of 0.1% of sulphur as part of the Mediterranean Sea Emission Control Area for Sulphur Oxides and Particulate Matter (Med SOx ECA) under regulation 14 of Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL). The measures were transcribed into EU Directive 2016/802 relating to a reduction in the sulphur content of

[280] https://www.imo.org/en/MediaCentre/HotTopics/Pages/Cutting-GHG-emissions.aspx#:~:text=The%20Initial%20GHG%20Strategy%20envisages,by%202050%2C%20compared%20to%202008
[281] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32015R0757
[282] The package contains legislative proposals to revise the entire EU 2030 climate and energy framework, including the legislation on the emission trading system, effort sharing, land use and forestry, renewable energy, energy efficiency, emission standards for new cars and vans, and the Energy Taxation Directive.
[283] The package contains legislative proposals to revise the entire EU 2030 climate and energy framework, including the legislation on the emission trading system, effort sharing, land use and forestry, renewable energy, energy efficiency, emission standards for new cars and vans, and the Energy Taxation Directive.
[284] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32015R0757
[285] https://ec.europa.eu/info/sites/default/files/fueleu_maritime_-_green_european_maritime_space.pdf
[286] https://ec.europa.eu/info/sites/default/files/revision_of_the_directive_on_deployment_of_the_alternative_fuels_infrastructure_with_annex_0.pdf
[287] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0563
[288] Directive (EU) 2019/883 of the European Parliament and of the Council of 17 April 2019 on port reception facilities for the delivery of waste from ships, amending Directive 2010/65/EU and repealing Directive 2000/59/EC
[289] https://www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx

certain liquid fuels (Sulphur Directive).[290] The Directive sets a 0.10% SOx limit in SOx Emissions Control Areas (SECAs) and as of 1 January 2020 a 0.50% limit outside SECAs in line with the IMO Global Sulphur Cap. Additionally, the previous iterations of the Directive set a 0.10% maximum sulphur requirement for fuels used by ships at berths in EU ports from 2008. Such requirements have over the years encouraged the uptake of OPS installation and fuel transitions in combination with the AFID (Alternative Fuels Infrastructure Directive)[291].

Not all requirements stem from the EU and there can, therefore, be regional and national rules in EU Member States which differ from one another, as is the case of the use of exhaust gas cleaning systems (EGCS). A number of EU Member States have banned the use of open-loop EGCS.

Box 14 Safety and security at sea

Safety and security are a high priority for cruise lines. The image of cruise tourism being a safe vacation option is a key selling point. The industry is not sustainable without high levels of safety and security. The CLIA provides a detailed description of its requirements for operational safety, shipboard security and fire protection, but cruise ships must also follow international EU regulation on safety and security.

The key international convention is the IMO's International Convention for the Safety of Life at Sea (SOLAS)[292] which covers all ships that carry passengers. The EU has implemented two Directives based on this Convention - Directive 2009/45/EC[293]) + Directive (EU) 2017/2108 of 15 November 2017 amending Directive 2009/45/EC on safety rules and standards for passenger ships[294]. Another Directive covers crew and passenger registration – Directive (EU) 2017/2109[295] of 15 November 2017 amending Council Directive 98/41/EC[296] on registration of persons on board, which is designed to facilitate any evacuation from the ship.

[290] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32016L0802
[291] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32014L0094
[292] https://archive.org/details/textofconvention00inte?view=theater#page/n5/mode/2up
[293] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32009L0045
[294] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32017L2108
[295] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2017.315.01.0052.01.ENG
[296] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31998L0041

10.3 Non-regulatory review

In the cruise tourism industry, **several non-regulatory measures address sustainability challenges and negative environmental externalities for cruise operators, port operators, and destinations alike**. These may include (voluntary) industry guidance documents, educational material and training, voluntary certification systems, International Organisation for Standardization (ISO) standards (when compliance with these standards is not legally mandated), and financial incentives, for instance in the form of port authorities providing incentives for greening through differentiated port levies for greener ships.

Other non-regulatory measures were noted in research for this study stakeholders as 'gap-filling' guidance where regulatory measures are unclear. This was, for instance, the case of the European Maritime Safety Agency (EMSA)'s LNG bunkering guidance material[297] and the EMSA guidance on OPS in ports published in July 2022[298]. EMSA also offers **guidance** on maritime safety. EMSA studies may well provide input to future regulatory measures, particularly those assessing the safety and viability of different fuel types. The IMO, ESPO and CLIA all offer additional training and educational materials to advance the uptake of sustainable practices by cruise operators.

Other non-regulatory measures enable stakeholders in the industry to go beyond regulatory compliance and be a source of good practice, e.g. the Environmental Ship Index[299], Cruise Lines International Association (CLIA) guidelines, and Blue Angel certification[300]. These non-regulatory measures are not binding and are, moreover, not always aligned with the gaps in regulatory frameworks.

Third-party certifications and ecolabels represent comprehensive operational guidelines that promote activities for port and cruise operators that exceed regulatory requirements. It illustrates that the majority of ecolabels require certain actions for the reduction of air emissions, mostly SOx, NOx, PM, and CO2, with some also including waste. The *Blue Angel* ecolabel[301], *EcoPorts*[302], and the *Green Marine*[303] Environmental Certification are the most all-encompassing non-regulatory measures containing requirements for nearly all areas of environmental impact, including for instance noise and grey water, with the *Blue Angel* ecolabel additionally applying circular economy principles in its eco-design label. In 2019, AIDAnova[304] was the first cruise ship to have been awarded *Blue Angel* certification for its eco-friendly ship design.

[297] https://www.parismou.org/sites/default/files/EMSA%20Guidance%20on%20LNG%20Bunkering.pdf
[298] EMSA Guidance on Shore-Side Electricity (SSE), accessible via: https://www.emsa.europa.eu/publications/inventories.html
[299] https://www.environmentalshipindex.org/
[300] https://www.blauer-engel.de/en
[301] https://www.blauer-engel.de/en/products/business-municipality/ship-design-until-12-2021/ship-design-edition-april-2013
[302] https://www.ecoports.com/
[303] https://green-marine.org/europe/
[304] https://www.carnivalcorp.com/news-releases/news-release-details/aidanova-first-cruise-ship-receive-blue-angel-certification-its

Box 15 Mixed views on the usefulness of non-regulatory measure

A representative of a major cruise operator for instance noted that: "***There are many more non-regulatory measures that the industry has taken and signed up to****, and those* ***guidelines are more comprehensive than the regulations****. We've signed up to CLIA guidelines, the Blue Flag agreements that we have signed in ports in Europe, ISO, and classification societies to get further classifications for ships.*" However, other stakeholders were more hesitant about the impact of non-regulatory measures. An official of HELCOM stated, for example, that: "*On a general level* ***they are impactful, but not as much as international legally binding regulations****. However, with recommendations and guidelines, there will always be some that choose to comply with them, and any reduction in environmental pressures is a good thing*."

Industry guidelines, such as those provided by CLIA, ESPO, EMSA, and the World Bank, together with those of the International Federation of Red Cross and Red Crescent Societies (IFRC), are providing the means for the cruise tourism industry to adopt more sustainable practices. ESPO's Good Green Practices[305] were reported by port authorities and NGOs consulted for this study to have had an impact on port operators. A new Advanced Methanol Amsterdam (AMA) biofuel plant is being built in the Port of Amsterdam to bring fuel production and supply closer to demand from the shipping industry. This will assist the port in providing the means of achieving GHG emissions reduction from those cruise vessels which are biofuel-capable.

There are a number of additional measures of relevance such as the IMO Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life,[306] IMO Guidelines for Exhaust Gas Cleaning Systems,[307] HELCOM recommendations,[308] the European Environment Agency Maritime Transport Environmental Reports,[309] and others.

Box 16 The value of guidelines during COVID-19

Guidelines, in this case guidelines from international organisations, government and industry proved their worth during COVID-19. World Health Organization advice and research was important in underpinning regulatory action taken by governments. In the EU the specific guidelines for the cruise industry were set out by EMSA and the European Centre for Disease Prevention and Control (ECDC)[310]. These guidelines were non-regulatory as the Member States could still decide to impose stricter or less strict rules for cruise ships operating under their flag or for the ports when a cruise ship enters their territorial waters[311]. The guidelines fell into three categories: *communication, prevention and event response*. EU Healthy Gateways, a programme co-funded by the European Union's Health Programme (2014-2020), released advice on restarting cruise ship operations and this was regarded a one of the leading non-regulatory guidelines for the restart of the cruise industry. The CLIA issued its own guidelines, which were often even stricter than the guidelines set out by the EU Healthy Gateways or EMSA, and were mandatory for CLIA members.

[305] http://www.espo.be/practices

[306] https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/833%20Guidance%20on%20reducing%20underwater%20noise%20from%20commercial%20shipping,.pdf

[307] https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.259(68).pdf

[308] https://helcom.fi/helcom-at-work/recommendations/

[309] https://www.eea.europa.eu/publications/maritime-transport/

[310] https://www.ecdc.europa.eu/en

[311] COVID-19: EU Guidance for cruise ship operations, 12 May 2021 (Revision 1)

Figure 38 Overview of coverage of some of the main non-regulatory measures: Industry Guidance

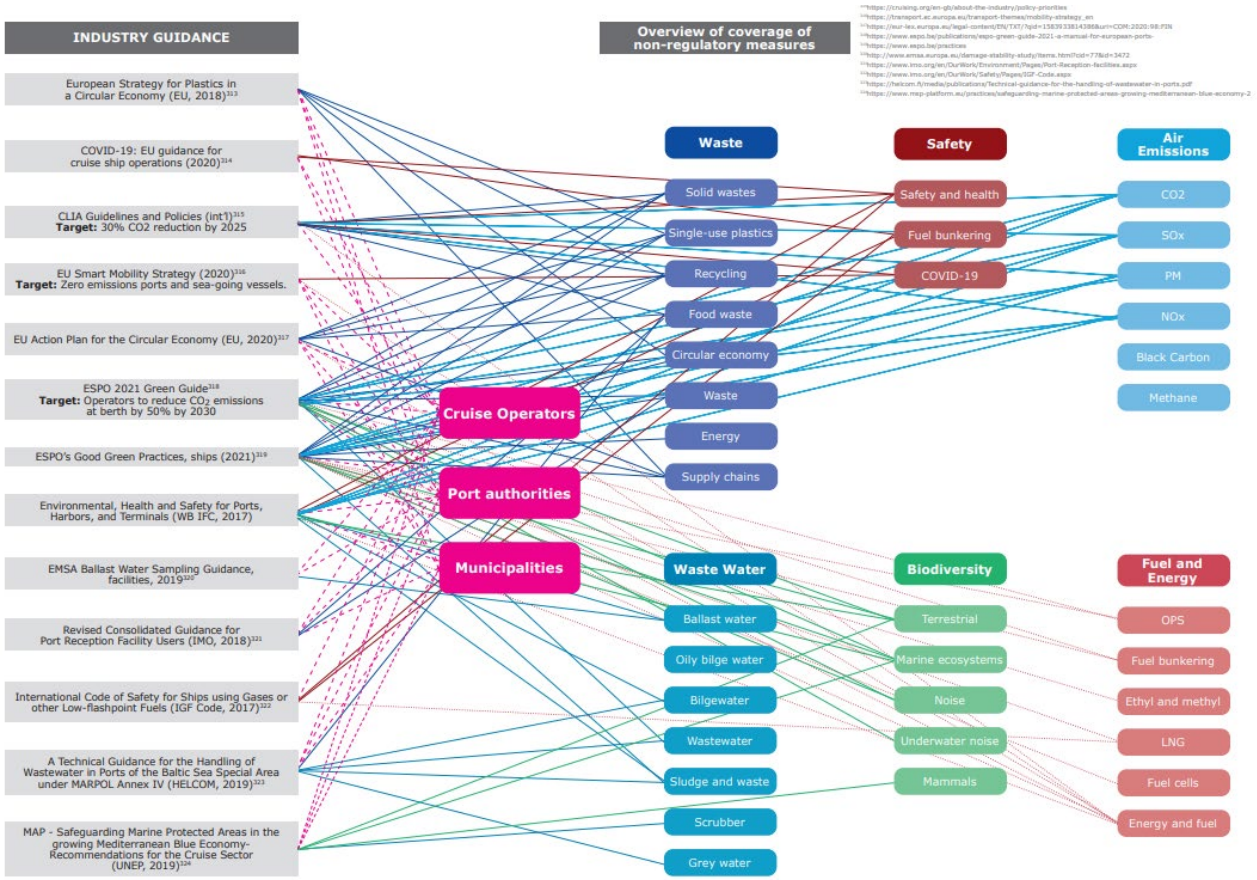


Figure 39 Overview of coverage of some of the main non-regulatory measures: Certifications and Ecolables

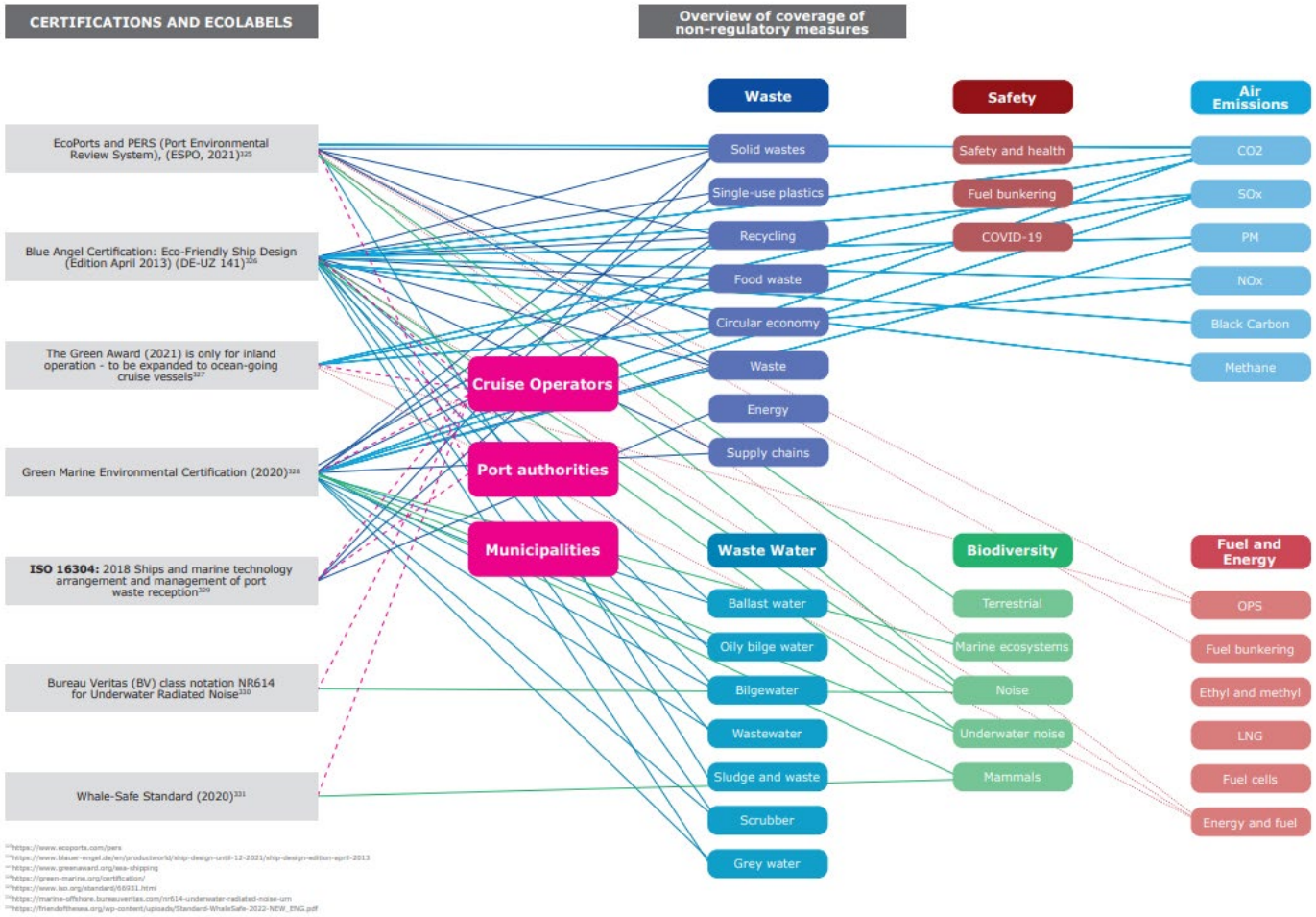


Figure 40 Overview of coverage of some of the main non-regulatory measures: Educational Materials and Training

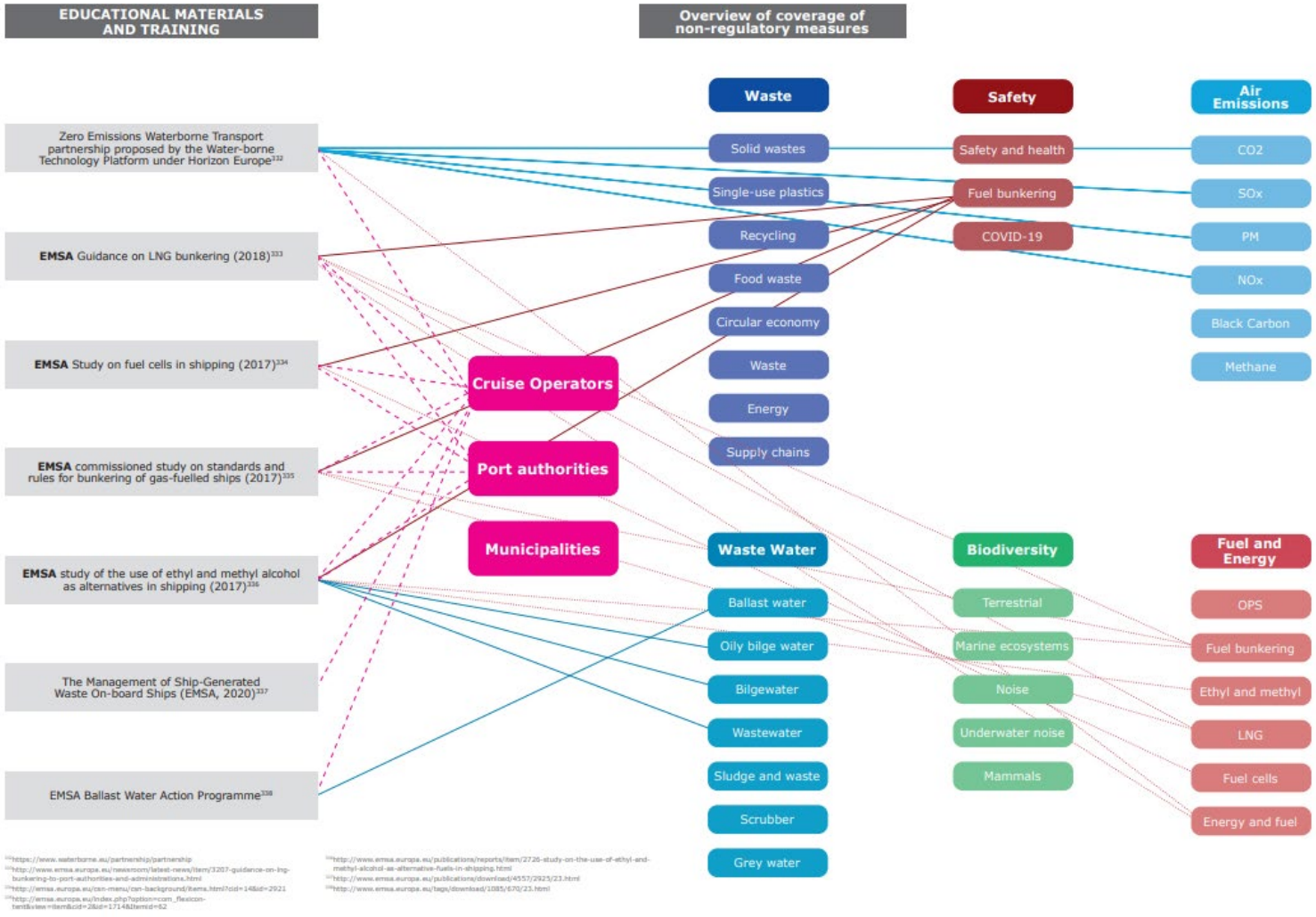
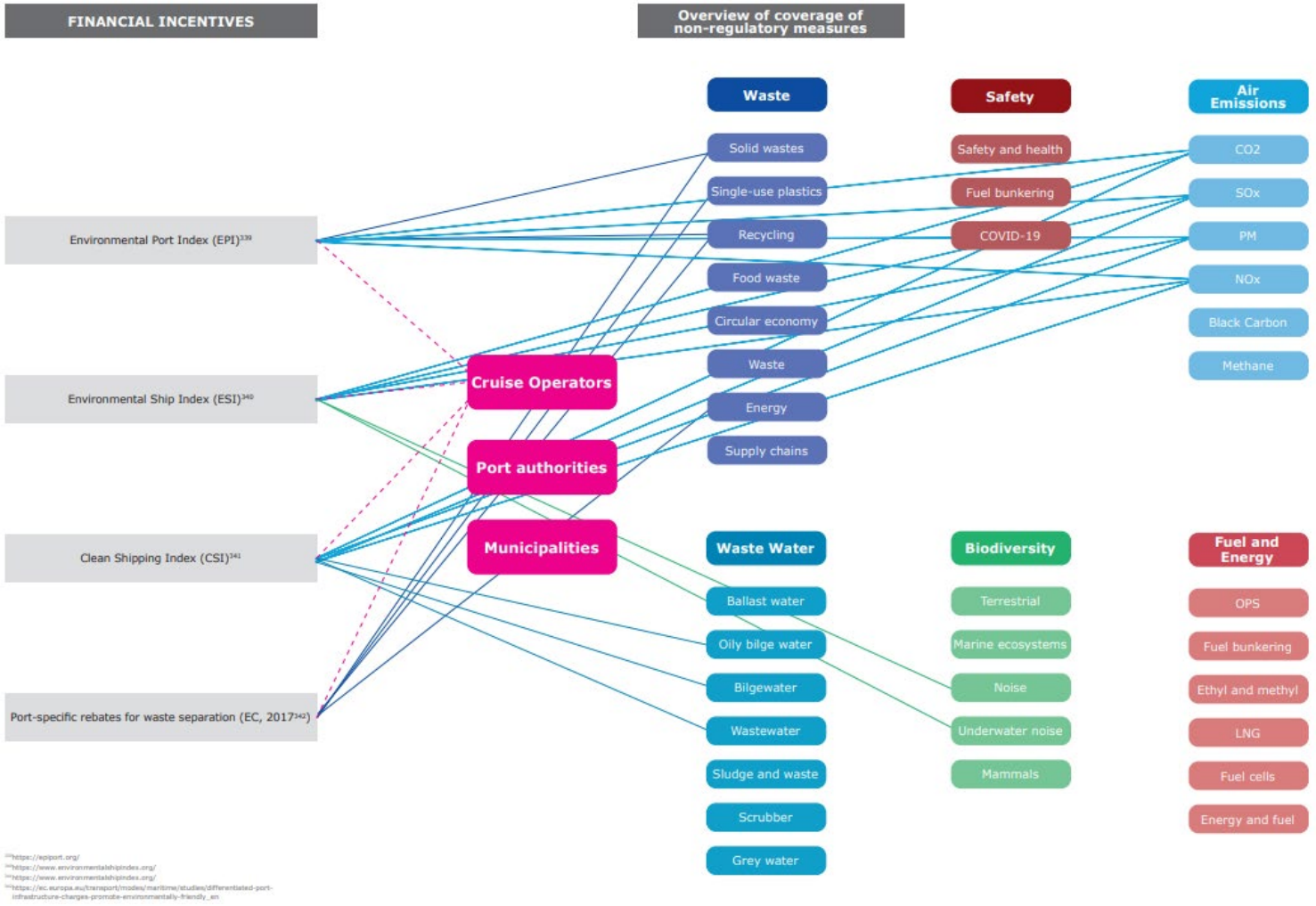


Figure 41 Overview of coverage of some of the main non-regulatory measures: Financial Incentives



Box 17 Gaps in regulation

Despite the wealth of regulation, not all potentially environmentally harmful impacts are regulated. The research for this study has identified **gaps** in the coverage of **food waste, grey water, under and overwater noise, black carbon, scrubber wash water, and mammal collisions as regulatory gaps, or areas with regulatory uncertainty.**

In the case of under- or overwater **noise pollution,** there are, however, IMO Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life[312]**.** The Bureau Veritas class notation NR614 for Underwater Radiated Noise and DNV Silent-E class notion do provide frameworks for reducing underwater noise[313] [314], while the Green Marine Environmental Certification[315] offers guidance for reduction of under- and overwater noise, thus encouraging the uptake of the ISO 17208-1:2016 underwater noise standard measurement methodology[316]. ESPO has found that 23% of ports providing differentiated dues for greener vessels specifically reward ships that reduce noise in ports.[317]

Finally, through the Environmental Ship Index (a financial incentive for ship reduction of SOx, NOx, PM, and CO2) Project NEPTUNES is looking into noise coming from seagoing vessels at berth. Vessels that have implemented NEPTUNES[318] can deliver a measurement report to get ESI-noise points, as a separate score in addition to ESI-air points, entitling them to additional rebates at port. The Environmental Ship Index (ESI)[319] is one of three sources of economic incentive. The others are the Clean Shipping Index (CSI)[320] and the Environmental Port Index (EPI)[321].

Mammal collisions are an area of weakness as they are covered by only one non-regulatory measure, the Whale-Safe ecolabel.

10.4 Findings

There is a wealth of regulation that applies to the cruise industry, much of it mandatory. However, there are many useful non-regulatory measures in the form of guidelines from government entities, NGOs and the cruise industry, as well as third-party certification and incentive schemes. These offer an opportunity to learn demonstrate good practice. Some measures cut across environmental impact categories while others are specific. There are nevertheless gaps relating to food waste, grey water, under and overwater noise, black carbon, scrubber wash water, and mammal collisions.

312 https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/833%20Guidance%20on%20reducing%20underwater%20noise%20from%20commercial%20shipping,.pdf
313 https://marine-offshore.bureauveritas.com/nr614-underwater-radiated-noise-urn
314 https://www.dnv.com/services/class-notations-noise-and-vibration-4712
315 https://green-marine.org/europe/
316 https://www.iso.org/standard/62408.html
317 https://www.espo.be/media/ESP-2844%20(Sustainability%20Report%202021)_WEB.pdf
318 https://neptunes.pro/
319 https://www.environmentalshipindex.org/
320 https://www.cleanshippingindex.com/
321 https://epiport.org/

CHAPTER 11: GOOD PRACTICES WITHIN THE CRUISE TOURISM ECOSYSTEM

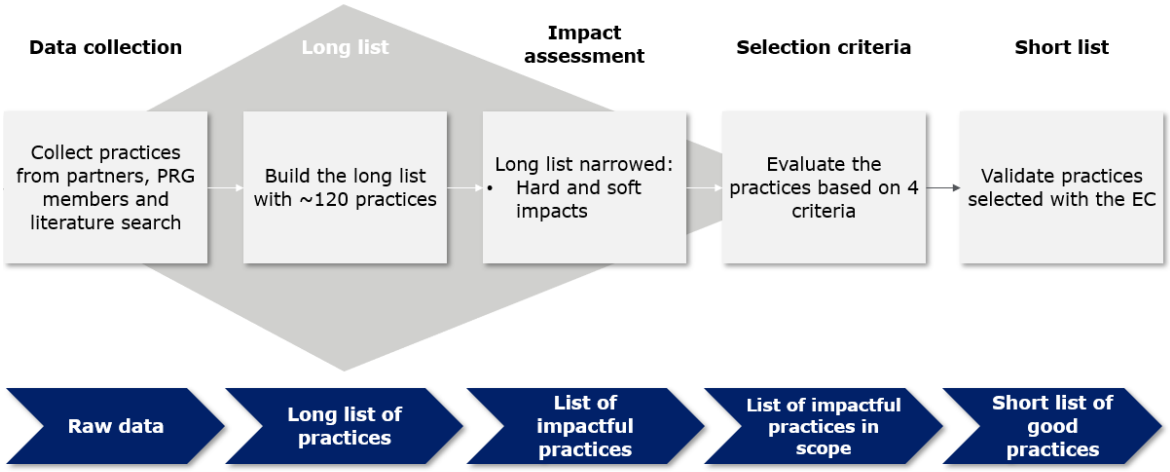
11.1 Introduction

The cruise tourism industry – in all its facets – can be considered proactive in trying to improve destination management, reduce its impact on the environment and increase its levels of social responsibility. In order to highlight examples of good practice for others to learn from, this chapter describes a methodology that led (on the basis of the findings from the previous chapters) to the selection of seven good practices. These good practices are described in more detail in Annex 1.

11.2 Methodology

The process to determine the final list of good practices consisted of five steps (Figure 42): (1) acquiring data from partners, PRG members and a literature search; (2) composing a long list of practices based on this input; (3) at a high level, assessing hard and soft impacts of the practices on the long list; (4) evaluating the practices based on four relevance criteria (collaborative, cruise-specific, availability of data on the impact of the practice, and EU-based (Figure 43); (5) validating the selected practices with the EC and PRG members to provide a final shortlist with seven good practices.

Figure 42 Methodology to derive a shortlist of good practices



Source: Deloitte/Ramboll analysis

11.3 Process adopted to gather input

A long list of more than 120 practices was generated based on various sources. PRG members[322] activated their partner network. Via this network and the PRG members, several practices were obtained. Additionally, desk research was conducted to provide an as clear and comprehensive as possible overview of the practices within the cruise tourism industry.

Assessment of hard and soft impacts

The practices on the long list (around 120) were evaluated based on several hard and soft impacts. Hard impacts include the economic, environmental and social impacts, while soft impacts include the practice structure, implementation effectiveness, and monitoring and reporting. The hard impacts were assessed based on a list of key

[322] PRG members consists of representatives from the cruise tourism industry

performance indicators (KPIs) inspired by the Global Sustainable Tourist Council (GSTC) criteria discussed previously. The soft impacts were assessed based on conversations with the practice owner in which several questions were asked, including:

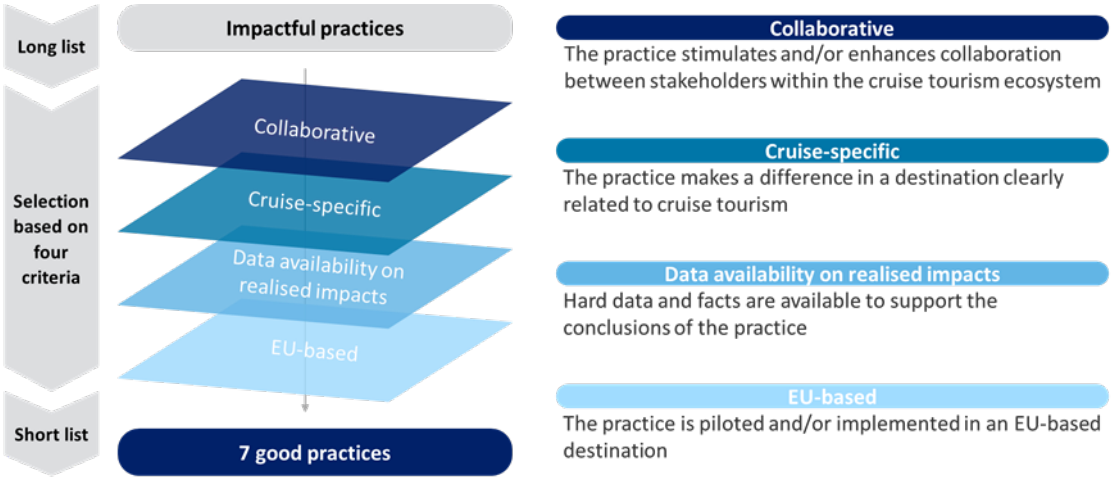
- How is the practice organised and is there stakeholder involvement?
- Is there a clear owner of the practice that communicates efforts needed by stakeholders?
- Is there communication across stakeholders?
- Do the stakeholders align on and agree with the goal of the practice?
- How effectively can the practice be implemented?
- Are there measures in place to follow up on the actions of the practice?
- Has there been any societal/stakeholder consultation?
- How well are the effects of the practice measured and reported?
- Is there any data collected on the effect of the practice?
- Is the effect of the practice reported on?

The answers to these questions should be positive for a practice to be eligible to be called a good practice.

11.3.1 The relevance criteria

After being assessed on relevant impacts, four relevance criteria were used to validate whether the good practices fell within the scope of the project. The four relevance criteria were a cruise tourism-specific practice, a practice that involves collaborative efforts, measurable sustainable impacts of the practice are available, and the practice is EU-based. This is illustrated in Figure 43.

Figure 43 Assessment of impactful practices using four relevance criteria



Source: Deloitte/Ramboll analysis

11.3.2 Contribution to the Green Deal

The contribution the good practice made to the EU Green Deal was also taken into account based on eight goals of the Green Deal:

- Increasing the EU's climate ambition for 2030 and 2050;
- Supplying clean, affordable and secure energy;
- Mobilising industry for a clean and circular economy;
- Building and renovating in an energy and resource-efficient way;

- Accelerating the shift to sustainable and smart mobility;
- From 'Farm to Fork': a fair, healthy, and environmentally friendly food system;
- Preserving and restoring ecosystems and biodiversity; and
- Zero pollution for a toxic-free environment.

11.4 The good practices

The funnelling of the long list, through hard and soft impacts, the four relevance criteria, and the relationship with the Green Deal resulted in the following seven good practices:

- Cruise-specific Onshore Power Supply (OPS) at the cruise terminal of Altona;
- Environmental Ships Index (ESI) at-berth module that calculates cruise ship emissions at the berth that it is planned to implement in various EU ports;
- Sustainable cruise terminal in the Port of Tallinn, Estonia;
- Holistic approach to tourism in Dubrovnik, Croatia;
- Waste reduction programme 4GOODFOOD implemented in at least 8 EU destinations;
- LNG bunkering at the Port of Barcelona, Spain;
- Waste treatment facility at the Port of Stockholm, Sweden.

11.4.1 Cruise-specific Onshore Power Supply (OPS) at Altona

Construction of an onshore power supply (OPS) in the port of Hamburg's Cruise Terminal Altona connects cruise ships to shoreside electricity supplies from renewable energy. The OPS in the port of Altona was the first OPS for cruise ships constructed in Europe. It is connected to the main grid[323]. The installation provides a total maximum capacity of 12 MVA. Two ships – AIDAsol (AIDA cruises) and Europe 2 (Hapag-Lloyd) - use it at the moment of writing.[324] Construction of the OPS started in June 2014[325] and the installation started working commercially in June 2016[326] [327]. The terminal is provided solely with energy from sustainable sources[328].

11.4.2 ESI at-berth module

This practice involves creating a system that calculates emissions of cruise ships when at berth, the so-called Environmental Ship Index (ESI) at-berth module which is currently in development and being piloted in 2023. This system will be implemented as a module in the Environmental Shipping Index (ESI), probably from 2023 onwards. The ESI at-berth module addresses the limitations for the cruise tourism industry of the current ESI. The module aims to improve transparency and clarity in the way cruise lines and operators provide ports with data on ship emissions at berth.

[323] https://safety4sea.com/siemens-develops-european-onshore-power-supply-for-cruise-ships-2/
[324] June, 2022
[325] http://www.bpoports.com/OPS_Seminar/Lebmeier.pdf
[326] https://www.monika-griefahn.de/en/2016/07/hamburgs-new-bridge-technology-shore-power-supply-at-the-cruise-center-altona/
[327] https://www.hafen-hamburg.de/en/press/news/shore-power-station-at-the-cruise-centre-altona-in-full-operation-for-one-year-ship-calls-soar-35749/?
[328] https://www.hamburg-port-authority.de/en/themenseiten/lng-shoreside-power

11.4.3 Sustainable cruise terminal in the Port of Tallinn, Estonia

Construction and maintenance of a sustainable cruise terminal in the Port of Tallinn (Estonia) has had a positive environmental and social impact on the city. As the terminal is located in the heart of the capital of Estonia, it was designed with an eye to the aesthetics and to reducing its negative impact on the environment. Before the building was constructed, various architects competed by submitting their designs for the cruise terminal. A jury of different stakeholder groups, including representatives of architects, the city government and the port authority, selected the design that maximised the advantages across different stakeholder groups and the city.

11.4.4 Holistic approach to tourism in Dubrovnik, Croatia

This practice involves collaboration between the City of Dubrovnik, cruise lines, and the Cruise Lines International Association (CLIA) with the aim of making cruise tourism more sustainable within the city. In 2019, the City of Dubrovnik and the CLIA signed a Memorandum of Understanding (MoU) on four key areas of focus[329] to stimulate more sustainable governance of the city. One of those areas is tailored specifically to sustainable cruise tourism.[330]

11.4.5 Waste reduction programme 4GOODFOOD

This practice is the Costa Crociere 4GOODFOOD programme. The aim of the programme involves halving food waste generated by the ships of Costa Crociere (a cruise line and subsidiary of Carnival Corporation). 4GOODFOOD is a food waste reduction programme aimed at reducing food waste on board Costa Crociere ships. The goal when it was set up was to reach or exceed the UN's Sustainable Development Agenda target of reducing food waste by 50% in 2020, ten years ahead of the UN's schedule. The programme is operated in partnership with Università di Scienze Gastronomiche di Pollenzo, Winnow, Cittadinanzattiva, and Fondazione Banco Alimentare Onlus[331].

11.4.6 LNG bunkering at the Port of Barcelona, Spain

This practice involves the use of two existing barges (Coral Methane and New Frontier 1) since 2019, and the construction of a new ship (Haugesund Knutsen) to bunker liquefied natural gas (LNG) ship-to-ship in the Port of Barcelona. These barges are used to bunker large LNG-powered cruise ships (and other vessels) in the Port of Barcelona. This practice is part of a wider programme aimed at fostering the use of LNG as an alternative, more sustainable fuel in the maritime sector. The wider programme aims to improve the availability of LNG support infrastructure for cruise ships, investments in bunkering barges, fixed LNG infrastructure, and the LNG fitting of vessels to support the development of LNG maritime bunkering stations in Spain. Ultimately, this programme supports the development of more sustainable cruise tourism.

11.4.7 Waste treatment facility at the Port of Stockholm, Sweden

This practice involves the smooth handling and processing facilities of waste of cruise ships by the Port of Stockholm (Sweden). The waste processing facilities in the Port of

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[329] (1) Engagement of key stakeholders, including the local community and international organizations, through the establishment of a dedicated working group; (2) Collaborating on a destination stewardship roadmap for the city based on UN sustainable tourism criteria; (3) Communicating and implementing the cruise ship berthing policy; (4) Developing and implementing the 'Respect the City' visitor education campaign

[330] https://cruising.org/en-gb/news-and-research/press-room/2019/july/cruise-industry-and-city-of-dubrovnik-partner

[331] https://hospitality-on.com/en/worldwide-hospitality-awards/costa-crociere/4goodfood-50-food-waste-2020

Stockholm excel as these are ran operationally sound and the majority of waste coming from cruise ships is recycled or converted to energy.

The Port of Stockholm follows a four-step process related to the disposal of waste onshore:

- Cruise lines submit the waste plan 24 hours in advance;
- Waste handlers – depending on the waste – are informed that a cruise ship will berth and the volume of waste to expect;
- When the cruise ship berths, the wastes are collected by the waste handlers. If cruise lines deliver at least three separate categories of waste (such as plastics, paper, and metal), cruise lines receive a discount on the berthing fees (13.5% of total received the discount in 2019);
- The waste handlers transport the wastes to a recycling plant. 65% of the waste is converted to biogas, district heating or electricity, 34% of the waste is recycled, and (only) 1% of the waste is landfilled[332].

11.5 Findings

While seven may seem to be a small number of good practices from across the whole industry, the criteria for excluding 113 others that were also considered were extremely rigorous, i.e. they had to be cruise-specific, collaborative, have a measurable impact, be EU-based and contribute to the EU Green Deal. There are certainly many elements of good practice in the industry to be found in the others that were reviewed, as there certainly are elsewhere in the cruise tourism industry.

[332] Representatives of the Port Authority of Stockholm, and the Swedish Waste Management Association, source: https://www.avfallsverige.se/fileadmin/user_upload/Publikationer/Svensk_Avfallshantering_2021_EN.pdf

CHAPTER 12: CONCLUSIONS

Introduction

The cruise tourism industry is important for Europe. It contributes to economic activity and generates jobs. The cruise industry may represent only a small fraction of total global tourism, but Europe is the second biggest cruise market after North America, both as a source of passengers and as a cruise destination. In a "normal" year, i.e. taking 2019, the last pre-COVID-19 year, as a baseline, it is a EUR 2 billion industry based solely on the economic impact of the cruise lines, their passengers and crew, of which the major part comes from the economic impact of the passengers. In addition, most of the world's large cruise ships are built in European shipyards.

This has been a strongly growing industry for several decades and the prospects for the future look good. There is doubt about exactly when supply and demand will return to pre-COVID-19 levels, but this is a structurally attractive industry that proved during COVID-19 that it is resilient and could call on the financial resources needed to weather a crisis. However, COVID-19 was a major external shock to this sub-segment of the coastal and maritime tourism industry: the economic impact of this industry dropped by some 85% in 2020.

This study has demonstrated nevertheless that the industry has many of the requisite strengths to ensure not only survival but ongoing growth. One of those strengths is strong demand for its services. Cruise passengers are loyal to cruising and are expected to have been only temporarily deterred by the blow to the industry's image from onboard outbreaks of COVID-19 at the start of the pandemic.

Without the cruise lines and demand for the cruising experience, there would of course be no cruise tourism. However, as this study has shown, the cruise lines do not and cannot operate in a vacuum. Sustainable growth relies on comprehensive destination management strategies, in which ports are a key but far from the only player. There is an ecosystem of cruise stakeholders and policymakers at international, EU, national and local level.

The whole ecosystem needs to be aligned if future growth is to be assured and at the same time sustainable. Cruise tourism, in the widest sense of the word, needs to be resilient on its economic, environmental and social dimensions if its growth and the EU decarbonisation ambitions are to be met.

The importance of taking future-proof decisions now

With a 40-year planning horizon for cruise ships, the cruise industry needs to ensure the decisions on their future direction that they take now will be future-proof and deliver against the background of the European Green Deal, the European Commission's new approach to the sustainable blue economy and its proposed Transition Pathway for Tourism. There are ambitious green targets to be met by 2030 in line with the EU's Fit-for-55 package and net zero to be achieved by 2050. The focus of the blue economy is shifting from mere exploitation to sustainability and resilience. The tourism ecosystem as a whole needs to meet the increasing demand for sustainable tourism and to take into account the net effect of tourism on local communities.

Future-proofing is urgent because stakeholders already face a major challenge in reconciling growth with the destination management, environmental and social challenges. The growth means more and larger ships (and thus more emissions and more waste unless mitigating action is in place), adding to a risk of overtourism in some destinations. That risk is already a reality in a number of major cruise destinations, either from cruise tourism alone or from the combination of cruises and other tourism.

Overtourism brings with it environmental and social pressures at the destinations, with cruise vessel berths typically close to inhabited areas. Many destinations are already struggling to cope with large numbers of cruise passengers during peak seasons – and struggling to find a balance between the interests of the cruise lines and local businesses to which they bring custom and local inhabitants' resistance to the noise, the air pollution, the waste and the overcrowding of their town centres.

In this landscape, ports can be critical enablers for the sustainability of the cruise industry. In some cases, provision of this infrastructure is driven by the regulatory requirements e.g. on the use of LNG or Onshore Power supplies. Ports are also driving sustainability with incentives to good green practice through port fee abatement, environmentally friendly investments or practice which go beyond regulatory requirements, and innovation in the circular economy. Like the rest of the ecosystem, they face challenges in infrastructure decision-making, however, from lack of regulatory certainty, high capital costs and uncertainty as to whether other players will make the necessary complementary investment.

Rising to the environmental and social challenges

The environmental challenges of moving to a net zero future in particular are daunting. There are a number of issues which it is important to address as a matter of priority as best as is technologically possible: emissions, particularly CO2, SOx and NOx from the fuel burned for propulsion, as well as waste water, particularly black water, ballast water and grey water, and certain forms of waste.

The technological transition path is not obvious. Green technologies to deal with these exist, at least on paper. However, many of these have some drawbacks, e.g. cost, technological immaturity, unsuitability for cruise ships, which need deck space for the cruise experience. Each solution has both advantages and disadvantages, and these change in line with technological advances and global megatrends within energy production – and energy costs. In no case, is there a winner-takes-all. The period to 2030 will be a key period for R&D, piloting, product development and commercialisation.

In the short-to-medium term the use of LNG with scrubbers to remove the toxic emissions is a direction in which the industry is moving but is still based on fossil fuels, and is probably only a mitigation measure until non-fossil alternative fuels are available. Connecting to an onshore power supply (OPS) is a technology that is available now. It cuts emissions in port, but is only truly energy-efficient if the power source is renewable. It is also an archetypical example of cruise lines and ports needing to invest in parallel, as the investment costs are high.

Longer-term, there are options such as hydrogen and biofuels, including biomethanol, or switching to batteries, or drawing some auxiliary power from renewables, but the technologies are not yet mature enough for use on cruise ships, the future cost-benefit is uncertain, and it is not clear what choices regulators will make.

Similarly solutions exist to dealing with waste, both by producing less and by treating it better at sea and on land, but they are costly and far from universally deployed at present. They too work best when ports and the industry ecosystem as a whole are working hand-in-hand with the cruise lines.

Energy efficiency, Onshore Power Supply (OPS), and voyage and data optimisation measures are low-hanging fruit, but the industry cannot decarbonise based on these alone. As a starting point the industry needs, where it has not done so already, to adopt clear environmental goals, adopt circular economy principles and step up collaboration across the ecosystem. It needs to plan a phase-out of sulphur from fuels and develop low-emission fuels, develop fuel flexibility capabilities and roll out zero transmission technologies. It needs to promote good practice and innovation in waste management

and accelerate the installation of supporting infrastructure and supply chains. These can all be considered 'no-regrets' measures.

The cruise industry also faces onshore social challenges (from overtourism) and onboard social challenges. There is extensive regulation on minimum standards, and these are met and in some cases exceeded, but seafarers' experiences differ greatly depending on their roles and responsibilities on the ships, contract provisions, policies of the cruise company that employs them, and Port State legislation. There is a difference between meeting the legal requirements and ensuring the well-being of crew, and there is sometimes a significant gap between the two.

Regulatory challenges

A further challenge for the cruise ecosystem is to keep abreast of evolving regulatory requirements and non-regulatory options. Most areas are already regulated either by international conventions or by the EU, either because the EU has transcribed those into its own legislation or because it legislates in other areas, particularly on environmental and social standards. This study nevertheless found gaps in regulation relating to food waste – clearly a major concern for the cruise industry with its large numbers of passengers and crew relative to other shipping, grey water, under and overwater noise, black carbon, scrubber wash water, and mammal collisions – cruise ships are among the largest on the seas.

Moreover, regulation on the environment is a moving target as governments keep up with the pace of technological change and, like the industry, tries to identify which way to head in the face of technological uncertainty. Regulatory uncertainty against a background of the types of issue identified in this study is undoubtedly a major current challenge.

Non-regulatory measures in the form of guidelines or ecolabels from government entities, NGOs and the cruise industry, as well as third-party certification and incentive schemes provide a framework for those who want to go beyond the minimum. These offer an opportunity to learn, to demonstrate good practice and to provide models for others to follow. But as with technology, the wealth of non-regulatory options illustrated in this study highlight a challenge in deciding which to follow.

Joined-up destination management planning is a must

All this calls for joined-up destination management planning, something which has hitherto been in short supply. That requires taking specificities into account. Some destinations are highly dependent on cruise tourism per se; for some it is important but secondary to other forms of tourism; in others it is secondary to the total volume of shipping activity in the port. Each business model will be different. There is no one-size-fits all. Common issues do not mean common solutions. What the destinations tend to have in common is a trend to quality over volume.

Both the absence of joined-up planning and the focus on quality were illustrated by the 13 destination case studies for this study. A number of leading cruise destinations have strategies and limits in place for moving away from untrammeled growth. However, even the front-runner in an assessment of destination management, environmental standards and the socio-economic dimension falls short on involving the local community in its planning.

Looking to good practice for lessons

In pondering which paths to take, cruise stakeholders can look to lessons learned from the good practices identified in this study. There are practices across a range of cruise players across the EU. They were chosen because they are based on cross-industry

collaboration, they are cruise industry specific, they are deployed in the EU, their impact can be measured, and they fulfil one or more of the Green Deal goals.

Concluding summary

This study has demonstrated the challenges, but also good initiatives by the cruise stakeholders in moving towards a more sustainable cruise tourism in Europe. The sense of urgency is felt. 2030, and thus the EU Green Deal mid-term goals formulated in the Fit-for-55 package, is only eight years away. The goal of net zero carbon emissions is less than three decades away. For an industry, which relies on capital-intensive assets with a long payback period, these goals are approaching rapidly.

Continued growth of cruise tourism seems assured, even if there is uncertainty about whether the industry will return to pre-COVID levels of activity in 2023 or 2024. That growth will falter if the ecosystem, including cruise lines, cannot meet the destination management, environmental and social challenges it is currently confronting. With a 40-year planning horizon for cruise ships, all stakeholders need to ensure the decisions they take now will be future-proof.

This study demonstrated the complexity of that decision-making, both because it needs to involve the whole eco-system and because the technologies of the future are not yet mature and the relative costs and benefits uncertain. This study has also pointed to a number of no-regrets measures that the industry can take now, both in planning and capturing energy efficiency gains and adopting some technologies that are mature or maturing.

Balancing the interests of all cruise stakeholders in that process is crucial. Striking the appropriate balance to protect and enhance resources while still meeting the needs of all stakeholders (at present and in the future) is a challenging task. Over the years, the European Commission has contributed to the process of a more sustainable cruise tourism industry by assessing the impact of initiatives, by stimulating initiatives via incentive schemes, and through regulation. On the way to a more sustainable cruise tourism in Europe, the European Commission will continue to leverage partnerships of cruise stakeholders in order to amplify joint efforts.

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