

Green strategies in the cruise industry: towards an overarching conceptual framework



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Agenda

1. Rationale of the study
2. Theoretical framework & research objectives
3. Research design and method
4. Green investment options in the cruise business
5. Business case analysis and results

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Externalities related to cruise industry

Positive

Direct:

Job creation, expenditures from passenger, crew and cruise operators' procurements, capital expenditures for cruise terminals, development of cruise tourism and transport facilities

Indirect:

Intention to return, intention to recommend the destination to relatives and friends (WoM).

Environmental impact:

Water consumption, wastewater treatment, emissions from engines, effluents solid waste, impacts on biodiversity and conservation

Socio-cultural issues:

Human rights protection, employment conditions, health and safety concerns, product responsibility, port destinations' overcrowding, etc.

(Fair) Economic impact:

Sustainable supply chains, equitability of arrangements with shore excursions providers, increasing competition between neighbour ports, risks related to the new ownership structure of cruise terminals

Negative

Positive externalities of cruise industry

Direct positive effect

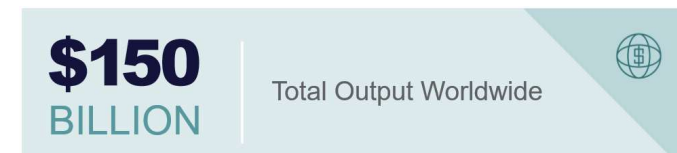
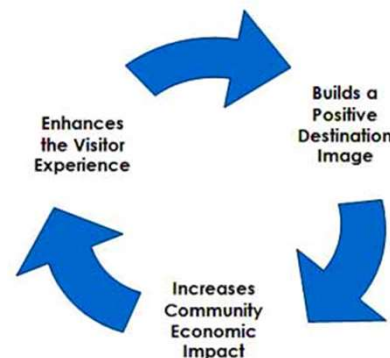
- ✓ *Job creation*
- ✓ *Expenditures from passenger*
- ✓ *Crew and cruise operators' procurements*
- ✓ *Capital expenditures for cruise ships & terminals*
- ✓ *Development of cruise tourism and transport facilities*



MSC's investment plan (2014 – 2026), involves the purchase of up to 11 new generation ships. The new orders (4 ships) correspond to an increase of about 4 billion euros of investments, which will bring the total value of the 10-year plan of the Company to about 9 billion euros.

Indirect positive effect

- ✓ *Intention to return*
- ✓ *Intention to recommend the destination to relatives and friends (WoM).*



Imbalance between positive and negative externalities in coastal regions

- **Positive externalities** of cruises are typically dispersed over a broad geographic space.
- Conversely, **negative externalities** produced by cruise lines (e.g., crowded streets, congested roads, etc.) are predominantly concentrated in coastal regions and, especially, in port cities.

Environmental pollution of cruise industry is considered the most urgent issue by **local communities** (and societal groups of interests) and **policy makers** since it harms the quality of life of people living in port cities.



Environmental impact

Water consumption

Wastewater treatment

Emissions from engines

Effluents solid waste

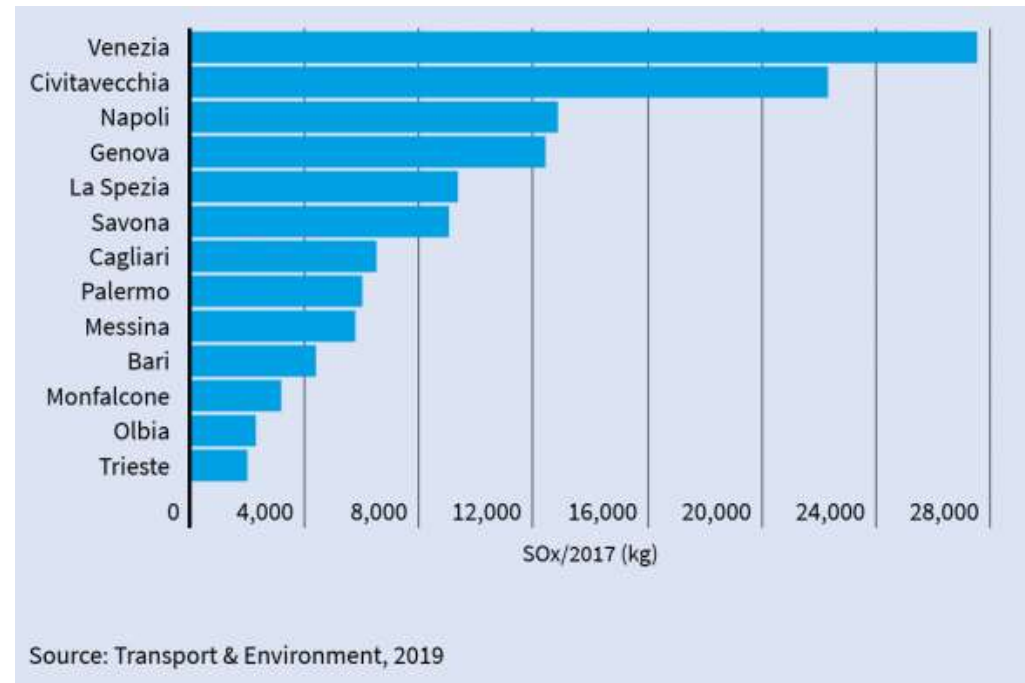
Impacts on biodiversity

Impact on coastal regions

The Transport & Environment study shows that: 203 cruise ships that sailed over European territorial seas in 2017 have produced:

- **62.000 tons** of sulphur oxides into the atmosphere
- **155.000 tons** of nitrogen oxides
- **10 mln tonnes** of CO₂ (equal to that emitted by Latvia, Luxembourg and Cyprus together).

The estimate of **sulphur oxides (SO_x)** being 20 times higher than the emission of the entire automotive industry operating in the European Union (around **260 million vehicles**).



Among the top 50 most polluted coastal cities, 10 are in Italy (relevance of cruise ships' emissions).

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Environmental impact of cruise industry: literature review



Authors	Year	Source	Main environmental impacts debated
Paiano A., Crovella T., Lagioia G.	2020	Tourism Management	GHG emissions; Waste and Effluents
Sanches V.L., Aguiar M.R.D.C.M., de Freitas M.A.V., Pacheco E.B.A.V.	2020	Marine Pollution Bulletin	Waste and Effluents
Perić, T., Golub-Medvešek, I.	2019	Journal of Applied Engineering Science	Biodiversity; Waste and Effluents
Ruiz-Guerra I., Molina-Moreno V., Cortés-García F.J., Núñez-Cacho P.	2019	Heliyon	Air pollutants
López-Aparicio S., Tønnesen D., Thanh T.N., Neilson H.	2017	Transportation Research Part D: Transport and Environment	Air pollutants; GHG emissions
Papaefthimiou S., Maragkogianni A., Andriosopoulos K.	2016	International Journal of Sustainable Transportation	Air pollutants; GHG emissions
Ballini F., Bozzo R.	2015	Research in Transportation Business and Management	Air pollutants; Energy
Carić H., Mackelworth P.	2014	Ocean and Coastal Management	Air pollutants; Biodiversity; GHG emissions; Waste end Effluents
Jing L., Chen B., Zhang B., Peng H.	2012	Environmental Reviews	Waste and Effluents
Klein R.A.	2011	Journal of Hospitality and Tourism Management	Air pollutants; Biodiversity; Light pollution; GHG emissions; Noise pollution; Waste end Effluents
Poplawski K., Setton E., McEwen B., Hrebnyk D., Graham M., Keller P.	2011	Atmospheric Environment	Air pollutants
Tzannatos E.	2010	Atmospheric Environment	Air pollutants
Eijgelaar E., Thaper C., Peeters P.	2010	Journal of Sustainable Tourism	GHG emissions
Copeland, C	2009	Washington, DC: Congressional Research Service.	Biodiversity; Waste and Effluents
Klein, R. A.	2003	Canadian Centre for Policy Alternatives	Air pollutants; Biodiversity; GHG emissions; Waste end Effluents
Johnson D.	2002	Marine Policy	Biodiversity; Materials; Waste and Effluents

2. Theoretical framework & research objectives

Research objectives

New challenges for cruise lines

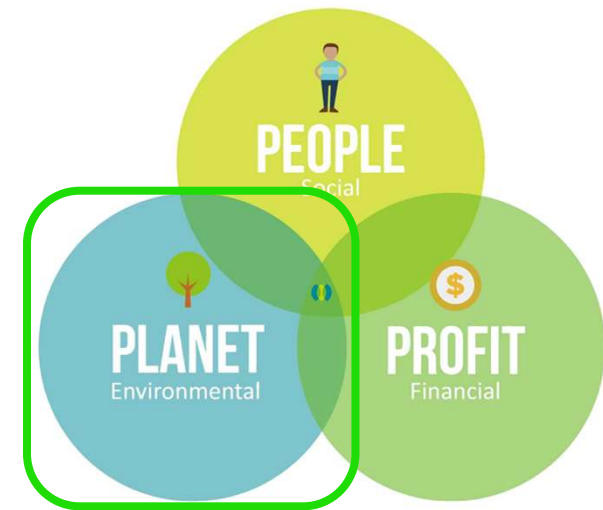
- ✓ Greater awareness of environmental externalities related to cruise industry
- ✓ Increasing regulatory pressure
- ✓ Greater pressure of media & public opinion



Cruise lines are triggered to **reinforce/manage** the **relationship** with local communities to face **environmental issues**:

- ✓ Increasingly attention to **Corporate Social Responsibility**
- ✓ Implementation of **Green strategies**

CSR strategies



Green strategies

- **OBJ 1. Developing an ad-hoc conceptual framework** for disentangling **viable green strategies** in the cruise domain (alternative technologies, assets and equipment)
- **OBJ 2. Testing the framework on leading cruise lines** for investigating the actual “adoption rate” of various green strategic options thus providing an in-depth overview of the current state of the art in the industry.

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Research design

- **Mapping environmental impacts:** For the aim of this study, we first categorize negative environmental impacts of cruises grounding on the Global Reporting Initiative (GRI) Standards (2018) and Carbon Disclosure Project (CDP). We adapted their taxonomies to the cruise business' specificities.
- **Proposing a conceptual framework which disentangles green strategies in cruise industry** (technologies and technical solutions): Paving on both mainstream academic literature (over 50 relevant academic contributions) & recent anecdotal evidence, reported in sectorial press release and media.
- **Developing a “green strategies vs. environmental benefits” matrix:** Five categories of green strategies are identified and, for each of them, alternative investment options are compared and discussed, before evaluating the related environmental benefits.
- **Testing the conceptual framework:** Multiple case analysis, scrutinizing the current effective adoption rate of each green option by major cruise line groups (i.e., Carnival Group, Royal Caribbean International & Norwegian Cruise Line). The sample timeframe ranges from 2015 to 2019. Around twenty operating cruise companies and branches investigated.

Taxonomy of environmental impacts



Environmental impact	Description
Air pollutants	Nitrogen oxides (NO _x), sulphur oxides (SO _x), and other significant air emissions; Combustion emissions from burning waste.
Biodiversity	Operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas; Significant impacts of activities, products, and services on biodiversity, habitats protected or restored; IUCN Red List species and national conservation list species with habitats in areas affected by operations; Direct or indirect impacts on biodiversity (species affected, area impacted, duration of impacts, reversibility or irreversibility impacts).
Effluents and Waste	Waste by type and disposal method; Significant spills; Transport of hazardous waste; Total waste excluding recycling value; Waste in shipboard incinerators; Waste generated in operation; Waste-to-landfill per passenger.
Energy	Energy consumption (electric consumption; heating consumption; cooling consumption; steam consumption) inside and outside the organisation; Energy intensity and reduction of consumption; Energy efficiency.
GHG emissions	Direct GHG emissions (from fuel to propel the ships and run the ships generators to provide electricity); Energy indirect GHG emissions (from ship refrigerants to cool appliances such as refrigerators and air conditioning units on the ships); Other indirect GHG emissions; GHG emissions intensity; Reduction of GHG emissions; Emissions of ozone-depleting substances; Shore direct GHG emissions from electricity purchased at the port of call for power the ship while docked (cold ironing) or for power the corporate and brands headquarters buildings and the land-based hotels.
Light pollution	Light pollution, both at sea and at port; Distresses and harms to animal species and other living beings.
Materials	Non-renewable materials used; Percentage of non-recycled input materials; Percentage of non-reclaimed products and their packaging materials.
Noise pollution	Noise emissions, especially at port and near densely populated area; Underwater noise emission.
Water and Effluents	Management of water discharge-related impacts; Water consumption. Water withdrawal from different sources (ocean; river; rainwater, etc.); Water consumption from shoreside operations; Disposal of oil bilge water, black water and grey water; Usage of potable water.

- Grounding on **GRI Standards and CDP** we propose an ad hoc framework for addressing the environmental impact of cruise lines.

Methodological issues

- **Method:** multiple case study analysis
- **Sampling:** selection of top cruise lines worldwide with Sustainability or Environmental Report available
 - ✓ Carnival Corporation
 - ✓ Royal Caribbean International
 - ✓ Norwegian Cruise Line
- **Data gathering**



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OBJ 2. Viable green investment options (1/3)



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Green strategies	Investment options	Environmental benefits									
		Materials	Energy	Water and Effluents	Biodiversity	GHG emissions	Air pollutants	Noise pollution	Effluents and Waste	Environmental Compliance	Supplier Environmental Assessment
Ship propulsion systems and alternative fuels	Integrated Electric Propulsion (IEP)										
	Diesel-electric engines										
	Wind power										
	VLSFO/ULSFO										
	LNG							(with gas turbine)			
	Biomass/biofuel										
	Hydrogen power										

✓ LNG benefits

- ❖ Air emissions reduction: 20-25% of GHG, 85% of NOx emissions, 95% of PM, 100% SOx emission.
- ❖ Cost savings, estimated around the 35% of operational costs by combining the effects of both lower energy consumption and the positive impact of the LNG's price which is currently low.
- ❖ The adoption of gas turbine instead of dual-fuel engines could also allow to reduce air and underwater noise originating from cruise operations with significant beneficial effects for marina faunas and local communities.

No environmental benefits	
Low environmental benefits	
High environmental benefits	

OBJ 2. Viable green investment options (2/3)



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Green strategies	Investment options	Environmental benefits									
		Materials	Energy	Water and Effluents	Biodiversity	GHG emissions	Air pollutants	Noise pollution	Effluents and Waste	Environmental Compliance	Supplier Environmental Assessment
Technical solutions for energy and environmental efficiency	Exhaust Gas Cleaning System (scrubber)								possible negative impact		
	Hull air lubrication (bubble technology)										
	Fuel saving propeller attachment										
	New bulbous bow (nose job, goose neck bulb)										
	Fuel Saving Technology										
	Retrofit Heating, Ventilation and Air Conditioning (HVAC) system										
	Electric energy efficiency systems										
	Solar power										
	Cold ironing										

- ✓ **Open-loop scrubbers** use seawater for the cleaning process: the water, after scrubbing the exhaust gas, is then treated and released in the sea. This process poses concerns related to water emission and may negatively impact on marine ecosystems in the surface ocean or sea.

No environmental benefits	
Low environmental benefits	
High environmental benefits	

OBJ 2. Viable green investment options (1/3)



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Green strategies	Investment options	Environmental benefits									
		Materials	Energy	Water and Effluents	Biodiversity	GHG emissions	Air pollutants	Noise pollution	Effluents and Waste	Environmental Compliance	Supplier Environmental Assessment
Ballast water treatment systems	Advanced wastewater purification systems (AWWPS)										
	Ballast water exchange										
	Onboard treatment										
Waste treatment systems	Waste reduction policies										
	Unsorted or separated waste compactor (Ecodyger, etc.)										
	Wet waste compactor (Converter NV, etc.)										
	Hazardous and chemical waste management										
Automation and digital intervention	Autonomous shipping										
	New digital technologies										

✓ Waste treatment system

- ❖ Among the onboard waste reduction policies, many cruise companies activate special policies aimed to use resources carefully and sparingly and to reduce the consumption of plastic on board.

No environmental benefits	
Low environmental benefits	
High environmental benefits	

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OBJ 2. Testing the conceptual framework

Cruise lines' commitment in green strategies

Green strategies	Investment options	Royal Caribbean	Carnival Corporation	Norwegian Cruise Line
Ship propulsion systems and alternative fuels	Integrated Electric Propulsion (IEP)	***		***
	Diesel-electric engines	***	***	***
	Wind power	*		
	VLSFO/ULSFO		***	*
	LNG	**	***	
	Biomass/biofuel	*		
	Hydrogen power	*	*	
Technical solutions for energy and environmental efficiency	Exhaust Gas Cleaning System (scrubber)	***	***	***
	Hull air lubrication (bubble technology)	***	***	***
	Fuel saving propeller attachment		*	
	New bulbous bow (nose job, goose neck bulb)	***	*	
	Fuel Saving Technology	**	***	**
	Retrofit Heating, Ventilation and Air Conditioning (HVAC) system	***	***	*
	Electric energy efficiency systems	***	***	***
	Solar power	*		
	Cold ironing	**	***	**
Ballast water treatment systems	Advanced wastewater purification systems (AWWPS)	***	***	***
	Ballast water exchange			
	Onboard treatment		*	
Waste treatment systems	Waste reduction policies	***	***	***
	Unsorted or separated waste compactor (Ecodyger, etc.)		**	
	Wet waste compactor (Converter NV, etc.)		**	
	Hazardous and chemical waste management	***	***	***
Automation and digital intervention	Autonomous shipping		*	
	New digital technologies	**	**	

Legend	
Assessment of cruise lines' commitment in green strategies	
	Not carried out / No information available
*	R&D and planned
**	Ongoing
***	Carried out

Main findings



- Options related to energy efficiency solutions & shore supply and those belonging to ship propulsion systems & alternative fuels are demonstrated to be a key part of green strategies pursued by leading cruise lines.
- Green strategies in this industry include a mix of both incremental and radical innovations.
- Whereas leading companies pursue predominantly isomorphic behaviours when developing new strategies for increasing their green attitude (see for example recent investments in diesel-electric engines or in LNG-propelled ships), some peculiarities emerge with regards to their green investment portfolios.
- Green strategies allow cruise lines to satisfy stakeholders' pressure, to increase their license to operate and the value created/distributed to customers. These strategies constitute an unprecedented opportunity for differentiating cruise packages and optimizing their cost structure.
- As green investment choices are the final output of a complex/articulated decision investment process, both financial evaluation criteria and comprehensive measurement/evaluation metrics are needed to assess also the environmental efficiency of each potential project.

Limitations & further research



➤ **Limitations**

- ✓ Data sources heterogeneity
- ✓ Opportunity to enlarge the sample cruise lines
- ✓ Lack of “internal validity”

➤ **Further studies**

- ✓ Selecting well-established KPIs for assessing environmental benefits in a standardized way
- ✓ Quantifying environmental benefits
- ✓ Ensuring “external validity”
- ✓ Disentangling facts & figures from statements & speeches



**Thank you for your
attention**

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