

**STUDY ON GREEN PORT STRATEGIES
NEW MANGALORE PORT AUTHORITY**

*Submitted to the School of Maritime Management, Indian Maritime University in
partial fulfilment for the award of degree in MBA Port and Shipping Management*

Submitted

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DECLARATION

I, **AVINASH B (Reg. No. 2103304004)**, student of School of Maritime Management, Indian Maritime University –Chennai Campus, hereby declare that this project report titled **STUDY ON GREEN PORT STRATEGIES NEW MANGALORE PORT AUTHORITY** submitted in partial fulfilment of the requirement for the degree of Master of Business Administration in Port and Shipping Management is my original work carried under the guidance of my project guide. It has not formed the basis for the award of any Degree/Diploma of any University/Institution. The information submitted is true and original to the best of my knowledge.



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Place: Chennai

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CERTIFICATE

This is to certify that the project report entitled "STUDY ON GREEN PORT STRATEGIES NEW MANGALORE PORT AUTHORITY", submitted to the School of Maritime Management, Indian Maritime University, Chennai Campus., in partial fulfilment for the award of the degree of Master of Business Administration in Port & Shipping Management, is a record of work carried out entirely by **Avinash B**, Reg. No. **2103304004**.



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Place: Chennai

Date: 16/5/23

ACKNOWLEDGEMENTS

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I'd want to express my gratitude, Indian Maritime University, Chennai Campus, and all Professors in the Department of SMM for providing me with all of the resources I needed to complete my research and project work.

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ABSTRACT

The New Mangalore Port Authority (NMPA) in India has implemented various green initiatives to promote sustainability in port operations. This study aimed to assess the effectiveness of these green port strategies and provide recommendations for improving green port governance. The research design employed in this study was mixed-methods, consisting of a survey of port stakeholders, interviews with port officials, and a review of secondary data. The findings revealed that NMPA has implemented various green initiatives such as the installation of solar panels, rainwater harvesting, and waste management systems. These initiatives have resulted in significant reductions in carbon emissions, energy consumption, and water usage, and have contributed to the overall sustainability of the port. However, the study also identified areas for improvement, such as the need for more comprehensive environmental policies, enhanced stakeholder engagement, and the adoption of innovative green technologies.

The survey results showed that stakeholders are generally satisfied with the green initiatives implemented by NMPA, with a majority of respondents agreeing that these initiatives have contributed to the sustainability of the port. Stakeholders also identified areas for improvement, such as the need for greater transparency in the implementation of green initiatives, more effective communication with stakeholders, and the need for more robust monitoring and reporting mechanisms.

The interviews with port officials revealed that NMPA has taken a proactive approach towards green port governance and has made significant investments in green initiatives. The officials also emphasized the importance of stakeholder engagement in the implementation of these initiatives and highlighted the challenges faced by the port in balancing economic development with environmental sustainability.

The review of secondary data provided further insight into the green initiatives implemented by NMPA, highlighting the achievements of these initiatives and their contribution to the sustainability of the port. The data also revealed that NMPA has set ambitious targets for reducing carbon emissions, energy consumption, and water usage, indicating a strong commitment to sustainability.

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CHAPTER 1

INTRODUCTION

1.1. Significance of the Study

The study on green port strategies for the New Mangalore Port Authority (NMPA) is of great significance for the long-term sustainability of port operations. Green port strategies refer to the implementation of environmentally sustainable practices in port operations, which can help reduce the environmental impact of port operations, bring economic benefits, demonstrate social responsibility, drive innovation, create a competitive advantage, align with government policies, and engage with stakeholders.

One of the most significant benefits of green port strategies is the reduction of the environmental impact of port operations. Port operations can have a significant impact on the environment, such as air pollution, water pollution, and noise pollution. The study can help identify and implement strategies to reduce the environmental impact of port operations. This includes the implementation of sustainable practices such as energy-efficient lighting and equipment, the use of renewable energy sources, and waste reduction strategies. By reducing the environmental impact of port operations, NMPA can comply with environmental regulations and standards and reduce its carbon footprint.

Green port strategies can also bring economic benefits to port operators. The implementation of sustainable practices can help reduce costs by decreasing energy consumption, water usage, and waste generation. For example, the use of energy-efficient lighting and equipment can reduce energy costs, while the installation of solar panels or wind turbines can provide renewable energy sources and reduce energy costs. Waste reduction strategies, such as recycling and waste-to-energy programs, can reduce waste disposal costs. By implementing these sustainable practices, NMPA can improve its bottom line and create a more financially sustainable port operation.

Green port strategies also demonstrate social responsibility and commitment to environmental sustainability. Ports have a social responsibility to the communities in which they operate, and the implementation of green port strategies can help build trust and enhance the reputation of NMPA. By demonstrating a commitment to sustainability, NMPA can engage with local communities and stakeholders, such as customers, suppliers, and environmental organizations. This engagement can help build a positive image and enhance the social license to operate for NMPA.

The implementation of green port strategies also requires innovation and the adoption of new technologies. The study can identify new and innovative technologies that can be applied to port operations, such as alternative fuels, electric vehicles, and smart grid systems. Implementing these technologies can position NMPT as a leader in sustainable port operations and attract new business opportunities. Additionally, innovation in green port strategies can also provide opportunities for collaboration with other ports and stakeholders in the logistics industry.

Green port strategies can also provide a competitive advantage for NMPA. Many companies are now looking for sustainable and environmentally friendly solutions in their supply chains. By implementing green port strategies, NMPA can attract these companies and become a preferred choice for their logistics needs. Additionally, NMPA can also benefit from the growing demand for sustainable logistics solutions and differentiate itself from other ports that do not prioritize sustainability in their operations.

Governments are also increasingly focusing on sustainability and environmental protection. The study can help NMPA align with government policies and regulations and access funding and support for sustainable port operations. Governments may also provide incentives for ports that adopt sustainable practices, such as tax credits, grants, and subsidies. By aligning with government policies, NMPA can gain support for its green port strategies and position itself as a responsible corporate citizen.

Finally, the implementation of green port strategies requires collaboration and engagement with stakeholders. The study can help NMPA engage with stakeholders, such as customers, suppliers, and local communities, and incorporate their feedback and suggestions into its green port strategies. This engagement can help build trust and enhance the social license to operate for NMPA. Additionally, collaboration with other ports and stakeholders in the logistics industry can provide opportunities for knowledge sharing and joint initiatives that can drive innovation and sustainability in the industry.

The study on green port strategies for NMPA is significant for the long-term sustainability of the port operations. It can help reduce the environmental impact of port operations, bring economic benefits, demonstrate social responsibility, drive innovation, create a competitive advantage, align with government policies, and engage with stakeholders. These benefits can help NMPA become a sustainable and preferred choice for global businesses in the logistics industry. The study can provide a roadmap for the implementation of green port strategies, monitor progress, and evaluate the effectiveness of these strategies over time. Ultimately, the

study on green port strategies for NMPA is of great significance for the long-term sustainability of port operations.

1.2. The Port System

The Indian Green Port System is a program initiated by the Indian government to promote sustainable practices in the country's ports. The program aims to reduce the environmental impact of port operations by implementing measures such as efficient energy use, waste management, and reduction of greenhouse gas emissions.

The Indian Green Port System involves the development of a comprehensive framework that includes a set of guidelines and standards for sustainable port management. The guidelines cover a range of environmental issues, including air and water quality, noise pollution, waste management, and biodiversity conservation.

Under the program, ports are required to implement a range of sustainable practices and measures, such as the installation of renewable energy systems, the adoption of green transportation methods, and the use of eco-friendly equipment and materials. Ports are also encouraged to engage in community outreach programs and promote environmental awareness among stakeholders.

The Indian Green Port System is an important initiative in the country's efforts to achieve sustainable development and combat climate change. By promoting sustainable practices in the port sector, the program can contribute to the reduction of greenhouse gas emissions and the conservation of natural resources, while also supporting economic growth and development.

Multiple pro-active measures have been undertaken to curb marine pollution in India such as:

1. Swachh Sagar Portal: To facilitate Port Reception Facilities.
2. Ratifying Hong Kong Convention: Portal for Objective Measurement of Safety, Environmental and Social Indicators.
3. Single Use Plastic Ban: Portal for facilitating replacement of SUP.
4. Risk Assessment of Indian Coast: Move towards ratification of Ballast Water Convention Mandatory Submission of Fuel Oil Consumption irrespective of Gross Tonnage.
5. Efforts towards Shore Power Supply.

In addition, National Action Plan has been prepared to promote green shipping in India with focus areas as:

1. Policy instruments for promoting Green Shipping.
2. Infrastructure for Green Shipping.
3. Technology and Solutions for Green Shipping.

Major Ports need to provide adequate reception facilities for proper disposal of waste from ships for disposal of oil residue mixture and garbage generated by vessels. In addition, ports shall ensure strict implementation of PRF guidelines as follows:

1. Ship master to report inadequacies of PRF at port.
2. Ship master to fill advance notification form for waste delivery to PRF.
3. Reception facility provider to fill waste delivery receipt.

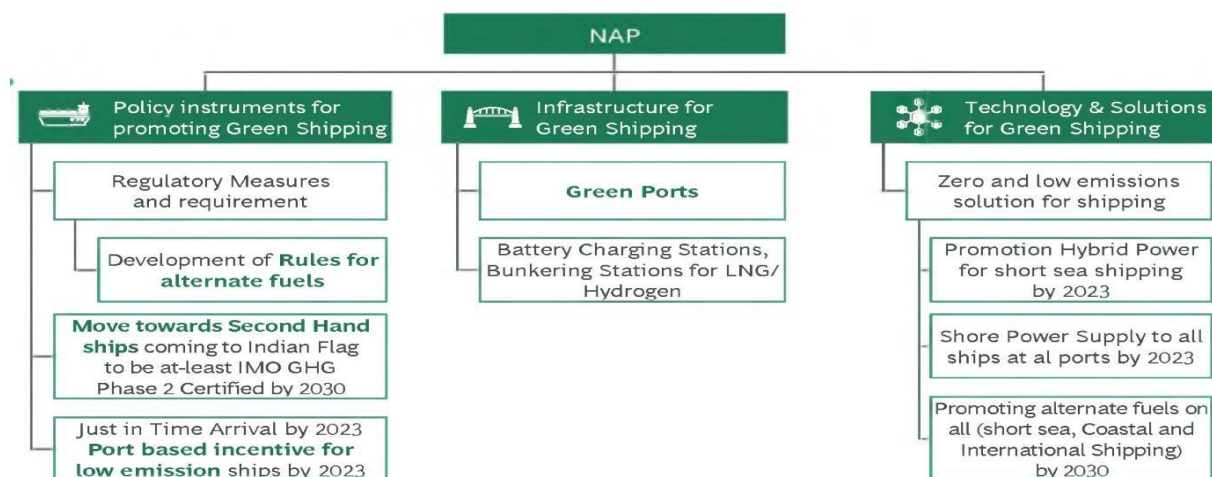


Fig 1.1 National Action Plan to promote green shipping

Source: MIV2030

1.3. Problem Statement

The Indian port sector has been growing rapidly in recent years, driven by increasing demand for trade and globalization. However, this growth has also led to environmental challenges, including air pollution, water pollution, and climate change. In response to these challenges, the Indian government has adopted green port strategies to promote sustainable development of the port sector.

Despite the government's efforts, there is limited research on the effectiveness of these strategies in promoting sustainable development in Indian ports. Therefore, the problem statement for this project is to conduct a comprehensive analysis of the growth and

development of Indian ports, specifically focusing on the implementation and effectiveness of green port strategies. The study will aim to identify the key drivers and barriers to the adoption of green port strategies and assess their impact on environmental and economic performance. The findings of the study will provide insights into the sustainability of the Indian port sector and inform future policy decisions related to the development of green ports in India.

1.4. Research Questions

The following are the questions that guide this project:

1. What are the current growth and development trends in the Indian port sector?
2. What are the key environmental challenges facing the Indian port sector, and how have these challenges been addressed through green port strategies?
3. What are the key drivers and barriers to the adoption of green port strategies in India?
4. What is the impact of green port strategies on environmental and economic performance of Indian ports?
5. How do green ports in India compare to non-green ports in terms of environmental and economic performance?
6. What are the best practices and lessons learned from selected green ports in India?
7. What are the policy recommendations for promoting sustainable development of the Indian port sector through green port strategies?

By addressing these questions, the study aims to provide a comprehensive analysis of the growth and development of Indian ports according to green port strategies and offer valuable insights into the sustainability of the Indian port sector.

1.5. Operational Definition

The element of port operations that executes and regulates the efficient, effective flow and storage of commodities from ship to shore to meet customer requirements is known as port logistics operations (researcher's definition).

Container Traffic: Container is defined as a method or article of transport in the UN/IMCO treaty of 1972 (quoted Rath 1975). **Berth:** a site where a vessel is tied or secured, or a spot alongside a quay where a ship loads or discharges goods. **Turnaround Time:** the time it takes for a ship to leave port after arrival.

Container Terminal: a place dedicated for the stowage of cargo in containers, generally accessible by truck, train, or maritime transit, where containers are picked up, dropped off, serviced, and housed.

Container Yard: A materials handling and storage facility for fully unitized cargoes in containers and/or empty containers. A place where freight travelling from one area to another is exchanged across transportation lines is known as a gateway.

Liner Ships: a vessel sailing between specified ports on a fixed route, at a fixed cost and a fixed time on a regular basis.

1.6. Scope of the Project

The scope of the Indian Green Port project would likely include initiatives and actions aimed at promoting sustainable and environmentally friendly practices in India's ports. Some potential aspects of the project could include:

Developing and implementing green port policies: This could involve working with port authorities, government agencies, and other stakeholders to develop policies that promote sustainability, reduce carbon emissions, and minimize environmental impact.

Improving waste management and recycling: The project could involve implementing waste reduction strategies, recycling programs, and waste-to-energy projects to reduce the amount of waste generated by ports.

Promoting clean energy: This could include increasing the use of renewable energy sources such as solar and wind power, as well as promoting energy efficiency measures such as the use of LED lighting and energy-efficient equipment.

Encouraging sustainable transportation: This could involve promoting the use of electric and hybrid vehicles within the ports, and encouraging the use of cleaner fuels and transportation modes for goods movement.

Enhancing environmental monitoring and reporting: The project could involve implementing environmental monitoring programs to track air and water quality, and reporting on progress towards sustainability goals.

Engaging with stakeholders: The project could involve engaging with local communities, NGOs, and other stakeholders to raise awareness about the importance of sustainability in ports and to gather feedback on the project's progress.

Overall, the Indian Green Port project would aim to promote sustainable development and reduce the environmental impact of India's ports, while also contributing to the country's broader goals of reducing carbon emissions and achieving sustainable development.

Here on the vision of MIV2030, Port authorities and operators face a number of challenges with respect to the role and impact of ports in sustainable development of coastal areas. The development and adoption of internationally benchmarked HSE standards by the maritime sector globally has emphasized that an effective management system must not only encompass operational activities, but also establish safety, health, and environmental objectives and procedures into each process. To achieve sustainability of port operations, authorities and stakeholders should be able to:

1. Manage the port's growth and development effectively.
2. Ensure safety and promote the health and welfare of workers.
3. Adhere to globally recognized environmental quality standards.

With economic factors driving the need for port operators to maximize revenues, it is necessary that ports optimize all available water, air, land and soil and societal space to the best of their ability.

To do so systematically, maritime operations have to establish a system of governance that specifically addresses these concerns and is designed by taking into consideration the nature of Maritime Operations in India. With increasing reliance on the coastal and international shipping for trade and commerce, India, has a large maritime sector to address. Its coastal areas have a rich biodiversity both on land and under the sea, and include estuaries, lagoons, mangroves, backwaters, salt marshes, rocky coasts, sandy beaches and coral reefs. These diverse coastal ecosystems, however, are exposed to increasing pressures. Indian Maritime Sector, specifically the Indian ports are obligated entities under Renewable Purchase Obligations (RPOs) and hence, need to actively focus on renewable power. Moreover, Indian Ports need to be in adherence with International Marine Organization's alignment to 9 UN SDG which includes obligations on safe, efficient and sustainable ports. It is therefore now critical that the ports in India have a well-defined road map towards becoming a Safe, Sustainable & Green sector.

Indian ports and maritime bodies need to focus on key environment, safety and health areas such as:

- Increasing Renewable Energy usage at ports.
- Improving Air quality at ports.
- Optimizing water usage and increasing green cover.
- Improving solid waste management.
- Dredging material recycling.
- Zero accidents, injuries or health hazards at ports.
- Centralized monitoring of KPIs and compliance to global standards.

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By using all this I'm going to analyse the Indian port growth towards the green port development strategies.

1.7. Methodology

The methodology for this project can be outlined as follows:

Literature Review: A comprehensive review of existing literature related to the growth and development of Indian ports and green port strategies will be conducted. This will involve collecting and analyzing data from various sources, including academic journals, government reports, and industry publications.

Data Collection: Data will be collected from relevant stakeholders, including port authorities, shipping companies, environmental agencies, and other relevant organizations. This will involve conducting interviews, surveys, and focus group discussions to gather information on the adoption and effectiveness of green port strategies.

Data Analysis: The collected data will be analyzed using appropriate statistical and qualitative methods. The data will be analyzed to identify the key drivers and barriers to the adoption of green port strategies, assess their impact on environmental and economic performance, and compare the performance of green and non-green ports in India.

Case Studies: Case studies of selected Indian ports that have implemented green port strategies will be conducted to provide a detailed analysis of the strategies implemented and their impact on environmental and economic performance.

Recommendations: Based on the analysis, recommendations will be developed for the Indian government and other stakeholders on the adoption and implementation of effective green port strategies for sustainable development of the Indian port sector.

Limitations: The limitations of the study, such as data availability and generalizability, will be discussed and appropriate measures taken to address them.

Overall, this methodology will provide a comprehensive analysis of the growth and development of Indian ports according to green port strategies, and offer valuable insights into the sustainability of the Indian port sector.

CHAPTER 2

REVIEW OF LITERATURE

2.1. Scope and Purpose of Literature Review

The literature review is an essential component of any research project. It provides a comprehensive analysis of existing literature on a particular topic, highlighting the key themes, trends, and gaps in research.

The scope of the literature review will depend on the research question and the specific focus of the study. It can be broad or narrow, depending on the research objective. The purpose of the literature review is to provide a critical evaluation and synthesis of existing literature, to identify gaps in research, and to provide recommendations for future research.

The literature review should identify the key themes and trends in existing research, highlighting the main arguments and findings of previous studies. The literature review should evaluate the quality and reliability of the research, assessing the strengths and weaknesses of each study. The literature review should identify gaps in research, highlighting areas where further research is needed. The literature review should provide recommendations for future research, suggesting areas for further investigation and potential research questions. The literature review should synthesize existing literature, bringing together the key findings and arguments of previous studies. The literature review should provide context for the research, highlighting the historical and theoretical background of the topic. The literature review should inform research design and methodology, providing insights into the strengths and weaknesses of previous studies and suggesting potential approaches for future research.

In summary, the scope and purpose of the literature review are to provide a comprehensive analysis of existing literature on a specific topic, identify gaps in research, and provide recommendations for future research. The literature review should identify key themes, evaluate the quality and reliability of the research, synthesize existing literature, provide context for the research, and inform research design and methodology.

2.2. Research Area

The research area of Indian port growth and development according to green port strategies has evolved significantly over the years. The concept of green ports emerged as a response to the growing concerns about environmental sustainability and the need to reduce the carbon

footprint of port operations. This analysis will trace the evolution of this research area, The early 2000s marked the beginning of increased global awareness about environmental issues, including climate change and pollution. These concerns also extended to the maritime industry, which prompted researchers and policymakers to explore sustainable practices in port.

Introduction of Green Port Strategies: In the mid-2000s, the concept of green port strategies gained prominence. Researchers started investigating ways to integrate environmental considerations into port planning, design, and operations. These strategies aimed to minimize the ecological impact of ports while ensuring their economic viability. **Sustainable Port Infrastructure:** Research began focusing on sustainable port infrastructure, including the use of renewable energy sources, green building materials, and energy-efficient technologies. Studies explored the potential for solar and wind power generation in ports, as well as the implementation of eco-friendly construction practices.

Environmental Impact Assessment: As the importance of environmental impact assessments (EIAs) became apparent, research in this area intensified. Studies aimed to evaluate the potential ecological consequences of port activities, including air and water pollution, habitat destruction, and marine ecosystem disruption. Researchers sought to develop comprehensive frameworks for conducting EIAs and mitigating environmental risks.

Alternative Fuels and Energy Efficiency: With increasing concerns about greenhouse gas emissions, research shifted towards identifying alternative fuels and energy-efficient practices in port operations. Studies explored the use of liquefied natural gas (LNG), battery-operated equipment, and shore power supply to reduce air pollution and carbon emissions. **Waste Management and Pollution Control:** Researchers recognized the significance of effective waste management and pollution control measures in green ports. Studies investigated strategies for proper handling and disposal of hazardous substances, waste reduction, and recycling initiatives.

Collaboration and Stakeholder Engagement: Another important aspect of green port research was the emphasis on collaboration and stakeholder engagement. Studies explored the role of various stakeholders, including port authorities, shipping companies, local communities, and environmental organizations, in promoting sustainable port development. The focus was on fostering partnerships and implementing effective governance structures for sustainable decision-making.

Policy and Regulatory Frameworks: The evolution of green port research also involved the development of policy and regulatory frameworks. Researchers analyzed existing regulations and proposed new guidelines to promote sustainable port development. This included incentivizing green practices, setting emission standards, and establishing environmental management systems for ports.

Technological Innovations: The advancement of technology played a crucial role in the evolution of green port strategies. Research focused on exploring digitalization, automation, and smart technologies to optimize port operations and enhance environmental performance. Studies examined the potential of artificial intelligence, Internet of Things (IoT), and big data analytics in improving energy efficiency, reducing congestion, and minimizing environmental impacts.

Integration of Sustainable Development Goals (SDGs): In recent years, there has been a growing emphasis on aligning green port strategies with the United Nations Sustainable Development Goals (SDGs). Research has explored the interconnections between port development and various SDGs, such as climate action, clean energy, sustainable cities, and responsible consumption and production. This integration aims to create holistic and inclusive approaches to sustainable port growth.

In conclusion, the research area of Indian port growth and development according to green port strategies has evolved significantly over time. From the early recognition of environmental concerns to the integration of sustainable development goals, research in this field has expanded and diversified.

2.3 literature review

21 studies were gathered and divided into their publication years for this study. The “green port” policy was launched in Port of Long Beach in January 2005 for the first time with a series of environmental protection plans developed from seven aspects. But there are not many researches between 2005-2010 about green ports, since it’s a new area. So, the studies from 2010 to 2020 were examined in this study. The chronology method has been chosen for to be able to analyze the research advancements in the area through the years.

The results when the articles divided to their publication years;

1 study in 2010, 2 studies in 2011, 2 studies in 2012, 2 studies in 2013, 2 studies in 2014, 2 studies in 2017, 1 study in 2018, 7 studies in 2019, 2 study in 2020.

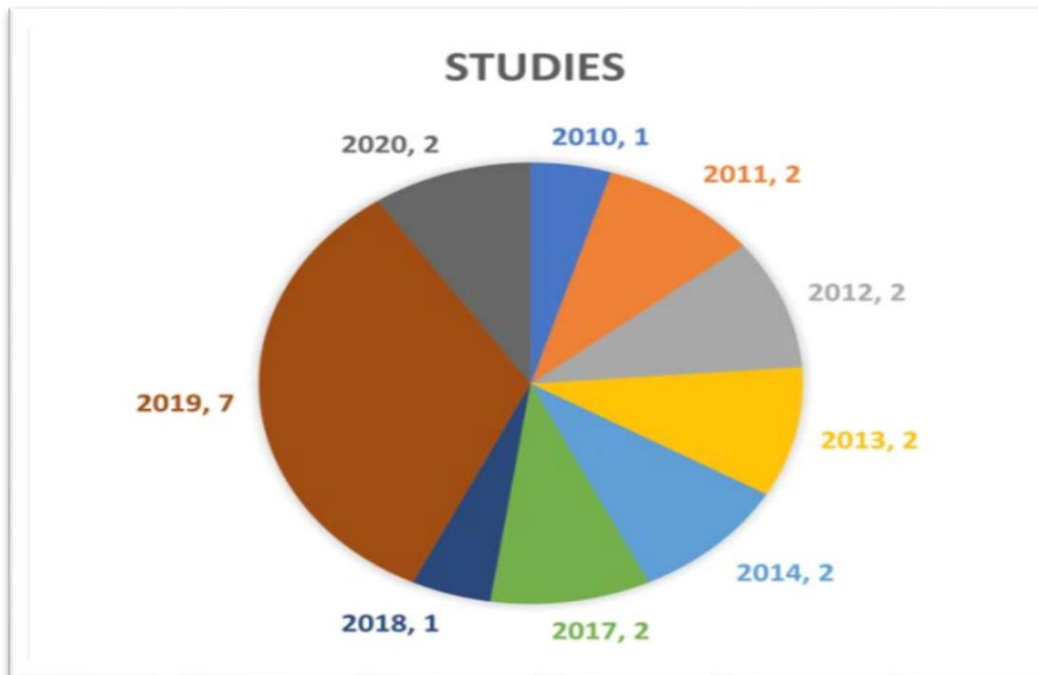


Table 1: shows the distribution of the examined studies according to the years.

Source: IJSET

YEAR	STUDIES	AUTHORS
2010	A Simulation for Optimum Terminal Truck Number in a Turkish Port Based on Lean and Green Concept	Soner Esmer, Ismail Bilge Cetin, Okan Tuna
2011	How will Greek ports become Green ports?	Despina Anastasopoulos, Dr. Stavros Kolios, Dr. Chrysostomos Stylios
2012	Evaluating the effects of green port policy: Case study of Kaohsiung harbor in Taiwan	Ching-Chih Chang, Chih-Min Wang
2012	Green port dues — The case of hinterland transport	Rickard Bergqvist, Niklas EgelsZandén
2013	Impacts of electric rubber-tired gantries on green port performance	Yi-Chih Yang, Wei-Min Chang

2013	An evaluation of green shipping networks to minimize external cost in the Pearl River Delta region	Y.H. Venus Lun, Kee-hung Lai, T.C. Edwin Cheng
2014	The Greening of Ports: A Comparison of Port Management Tools Used by Leading Ports in Asia and Europe	Jasmine Siu Lee Lam & Theo Notteboom
2014	SUSTAINABLE PORT INFRASTRUCTURE, PRACTICAL IMPLEMENTATION OF THE GREEN PORT CONCEPT	Boris SUCIC, Marko PECKAJ, and Bogomil KANDUS
2017	A Study on Green Shipping in Major Countries: In the View of Shipyards, Shipping Companies, Ports, and Policies	Taehee Lee, Hyunjeong Nam
2017	Contribution to the implementation of “Green Port” concept in Croatian seaports	Paola Badurina, Marijan Cukrov, Čedomir Dundović
2018	A novel model for the quantitative evaluation of green port development – A case study of major ports in China	Wan Chengpeng, Zhang Di, Yan Xinping, Yang Zaili
2019	Green port marketing for sustainable growth and development	Jasmine Siu Lee Lama, Kevin X. Li
2019	Differentiating on port fees to accelerate the green maritime transition	Alvar Mjeldea, Øyvind Endresena, Einar Bjørsholb, Caroline Wang Gierløffc,

		Even Husbyd, Johanne Solheime, Narve Mjøsa, Magnus S. Eidea
2019	Alternative Maritime Power application as a green port strategy: Barriers in China	Jihong Chen, Tianxiao Zheng, Akhil Garg, Lang Xu, Sifan Li, Yijie Fei
2019	Environmental Performance Indicators for Green Port Policy Evaluation: Case Study of Laem Chabang Port	Rattaporn TEERAWATTANA, YiChih YANG
2019	Evaluating the key factors of green port policies in Taiwan through quantitative and qualitative approaches	Po-Hsing Tseng Nick Pilcher
2019	Green port project scheduling with comprehensive efficiency consideration	Wei Wang, Li Huang, Jian Gu & Liupeng Jiang
2019	Analysis of the main factors for the configuration of green ports in Colombia	Abraham Londoño-Pineda, Tatiana Arias-Naranjo, Jose Alejandro Cano
2020	Enabling a green just-in-time navigation through stakeholder collaboration	Jordi Arjona Aroca, José Andrés Giménez Maldonado, Gabriel Ferrús Clari, Nuria Alonso i García, Lucía Calabria and Jorge Lara
2020	Identifying the appropriate governance model for green port management: Applying Analytic Network Process and Best-Worst methods to ports in the Indian Ocean Rim	Ziaul Haque Munim, Henrik SornFriese, Mariia Dushenko

LITERATURE REVIEW THROUGH THE YEARS

YEAR 2010:

Actually, researches mentioned the real concept of “green port” starts in 2011 but one article from 2010 has been included to this review for to be able to see the last approaches to the greening of ports before the creation of green concept. Normally, the articles which includes sustainability in ports, greening of ports are also considered as related to the green port concept but mostly the ones which has the key word of “green port” on their title has been included to this review, for to be more specific on the green port concept. In 2010’s article the main concept is not green concept but still the importance of green approaches on ports is mentioned through in the article. The general concept of the article is about lean port but, in the article, it was argued that lean production contributes to a decrease in the environmental damage. Overall, it shows us, the idea of greening ports is there in 2010 but the researches and concepts are not conducted in accordance. Also, its seen that greening of ports only mentioned in gas emissions dimension in 2010 but in the essence, it has more dimensions rather than only gas emissions and air pollution. This gives us a frame of in which level “green port” studies was in 2010, which was not detailed at all. But again, there is some facts which will give birth to other “green port” studies in the future.

YEAR 2011:

In 2011, we see the green port concept starting to take shape and more and more details are given in accordance with the concept. However, it’s mentioned in the form of a case study for on more specific regions that the concept can be implemented in. The common issues examined in the 2011’s articles are the affects and impacts of the current ports (which are not green ports) and current environmental analysis of these ports and also importance of sustainability in ports. The issue of sustainability in the port has gain popularity since 2009 when some countries signed a global agreement (Kyoto Protocol) to reduce greenhouse gas emissions, so it’s almost common for all of the port-related articles. However, the research of on how current ports impacts the environment is considerably new and also is one of the reasons which gave birth to green port concept. The further implication has been taken in one of the 2011’s article. The requirements of green port concept have been explained and suggestions are given for how to transform a port into a green port. Also, more specifically, the affected parties of current ports and the environmental benefits of the green port concept has been explained. Overall, in 2011, we see the first characterizations of green port concept, the comparison of current port with a green port and the requirements of a green port. Yet still, we see green port from one perspective which is environmental perspective. Of course, the concept itself is an

environmental concept but there is more dimension of green port should be examined in accordance with advantages.

YEAR 2012:

In 2012 while we see a specific region-based article, we also see an article covers the case of hinterland transportation which is a broader point of view. It can be considered as an improvement in the concept through the years. However, the one region-based article covers the effects of green port policy in only one dimension which is on air pollution. This time it can be considered as an improvement because the concept has been characterized before and the effects of the concept has been examined in one specific issue. On the other hand, a broader aspect of the concept has been examined in the other article and this time the demand for more sustainable transport solutions, green port's effectiveness and efficiency in terms of cost, quality and environmental impact has been explained. It's the first time the concept examined with its other dimensions. Another important issue is a whole different aspect of green port concept has been mentioned in one of the articles. The relationship between green port and the stakeholders of the port, the stakeholder's perspective and the implications for managerial practice has been discussed and this really brings a different side of the concept into the middle. Also, the dues of green port have been discussed for the first time too. Overall, we see that the new perspectives and approaches has been revealed about the concept during 2012. More details about green port concept have been mentioned and also the concept has got closer to implication process with studies getting more advanced in the area.

YEAR 2013:

There are interesting issues to be mentioned in 2013's articles. First of all, we see that one of the articles has a literature review part, which means enough studies and analysis has been conducted to be able to mention about a literature review even for to a part. In the first article of 2013, we see that the studies are getting more specific and the effects of certain tools or substances on the performance of the green port have begun to be examined. And again, in this context alternatives have been created or researched for these tools or substances. On the other hand, we see a really different approach in the second article, external cost has been used as a tool to assess the environmental impact of transport activities. Which means, environmental impact of ports has been tied to a cost even if its indirect. Also, the relationship of port development and environmental quality has been mentioned as if they are highly related. This approach can bring the notion of the relationship of competitiveness and green port, in the future. Overall, in 2013 we see the concept has been examined from the general to the more specific. Also, we see that articles started to be getting closer to actual advantages of green port

concept rather than environmental. The small sentences in the articles will give birth to whole different aspects for the concept, in the future.

YEAR 2014:

In 2014 we started to see the actual implementation of green port concept in ports around the world. That is the reason we see the implementation of the green port activities and actors involved and the methodological approach for the practical implementation of the green port concept, in of the articles. The common issues mentioned in the articles are the legislative environmental policies and the analysis of various green tools used by the port authorities. Which means that some of the countries actually required ports to become green and the green tools which were examined before in the last years have been used by the ports. And new findings were founded in accordance such as the more integrated these tools are used, the more effective the green port will be. This means a further step has been taken in accordance with the green port concept. Another important issue is that the articles are both now talking about the competitiveness dimension of green port concept. The comparisons of the old ports and green ports has been held throughout the articles. Now it is considered as a requirement for the competitiveness of ports and new approaches and further improvements are highly needed for the concept. Overall, we see much more detailed understanding of green port concept with much more mentioned dimensions. And the issues are getting more and more specific into the green tools. The concept itself has been framed but the need for more improved tools to be used in the concept is outstanding in the articles. And the concept being a requirement now means that it gained more popularity which can give birth to other actions taken by legal authorities in other countries, in the future.

YEAR 2015 & 2016:

In the year of 2015 and 2016, almost no article found which directly concerns the green port concept. At the beginning 2 articles were included for these years but later they have been removed. Because they were more on the side of sustainability in maritime business and sustainability in ports which will affect the purpose of this study by breaking the rule of relevancy rate which mentioned before. While choosing the articles for this study, it was the priority to make sure the articles have a concern about the green port concept itself. Actually, sustainability in ports is highly related to green port concept but the articles were removed just because the filtering method which is used for this study. On the other hand, we see that there was a need of improvement for the green tools will be used in the green port concept, in the last following years. That may be the reason there are lack of materials in these years because the

improvements in tools, machineries and substances may occur as an engineering or biology related studies.

YEAR 2017:

In 2017, we see finally see the real green ports around the world. One of the articles is all about the green criteria's implemented by the green ports around the world. To be more specific, all the green ports in the world and all of their green implementations has been mentioned country by country. Also, the legislations and regulations of the countries towards the green implementations in ports has been examined, again country by country. This article actually was not a good fit for this study because of the filtering method and had been removed in the beginning. But it has a big importance in the chronological development of the studies in the area, so it was worth mentioning in the review. On the other hand, we see a collective work in this year. One of the articles compiled all the articles written so far and mentioned about implementations of measures and dimensions of green port concept. With this, it's safe to say that Green Port concept's framework has been drawn because the other mentioned topic is the adoption of Green Port concept in the further development of seaports. Overall, in 2017 ports around the world are following green port concept and the legal authorities of countries are taking actions in accordance with greening of the ports. The researchers conducted in this field have started to repeat themselves and the need for new approaches and aspects towards green port concept occurred. Also, the ports which adopted green port concept are mostly located in the Europe and Asia, so further studies in other regions of the world can be expected in the following years.

YEAR 2018:

As expected, in 2018 the issues in the study were the lack of research for green port concept in developing countries. There has been enough research conducted about the concept in accordance to developed countries, but not really for the developing countries. That is the reason of 2018's study's one aim is to fulfill the lack of information for green port development considering both developed and developing nations. However, this time we see a different kind of study because study's main aim is to develop an assessment model for the evaluation of green port development, and did so by identifying drivers, pressures, states, impacts and resources of the green port development. As mentioned before there is a need for new approaches, aspects in the literature and this article fulfill this duty by developing a tool for the green port concept and covering up some of the missing issues so far.

YEAR 2019:

Most of the articles examined through this study are from 2019. As mentioned in the last following years, there were a need for new approaches and aspects about the study. And another need was for the studies conducted about green port concept in developing countries. In 2019, these needs were responded by the researchers. So, year 2019 section can be examined according to these needs. In the following paragraphs, 2019's articles will be examined in 2 parts; the ones which responses the need of new aspects and approaches and the ones which responses which responses the need for studies of green port concept implementation in developing countries. This may be the best method since there is more article in this section. The ones which responses the need for studies of green port concept implementation in developing countries has similar concerns. 2 of them are actually conducted for the same developing country. One of the outstanding content for all of the studies in this section is that all they all have a literature review part, since all most of the framework has been shaped in the last years. The common concerns are evaluation of the key factors and environmental performance indicator of the green port concept, the legislative requirements of these specific countries on green port policies. In one of the articles, an outstanding concern is about the countries which doesn't have any kind of legislative requirement of green port policies, because this time the commitment of management team of port authorities and societies towards green port policies gains more importance, so further studies in regard to this specific issue became a need. On the other hand, there is one article which concerns both of the parts in this section, because it's a new approach which consist alternative maritime power application as a green port strategy but discussed for a developing country. It can be considered as a further study of the article we mentioned in the year of 2018. Other than that, we don't see anything new in this part. The ones which responses the need of new aspects and approaches includes more real time issues after the implementation of the concept has been done by the ports. 3 new approach and aspect of green port concept has been examined in this part. And all of them examines the concept from its different dimensions. While in one of the articles the detailed port fees and incentives towards green port policy, the other one gives attention to green port project scheduling with efficiency consideration which develops an optimization model and, in the conclusion, reveals the payback of investing on green port policies. On the other hand, green port marketing has been discussed in of the articles, and it is a totally new aspect we see so far. The study takes the attention to marketing practices of green ports which represents the actual mean of the need for different aspects. Further studies are expected in this aspect of green port, because the approach needs and improvement on ideas and actually is a really important issue for green port concept since the concept's has an importance in the competition of ports. And this new approach may have an increasing effect in competition between ports. Overall, some

of the expectations for the concept were responded in this year and these responses gave birth to new expectations for further studies in the newly developed aspects. The further studies and explanations are expected in the marketing and managerial aspects of the green port concept. Also, the studies about green port practices of countries which has weaker economies is expected in the future years.

YEAR 2020:

As expected, in year 2020 we see a study about the green port concept combined with its implementation in a country which has a weaker economy. However, these two aspects were expected to be studied separately. Because there was lack of information about these two aspects, so “little bit of this, little bit of that” approach is not quite suitable as of now. On the other hand, again we see another 2-aspect combination in the other article. This time the idea of Green Just-in-time navigation for the ports has been developed. It’s overall a new aspect and approach for the concept. However, the study is not a 100% good fit for this review because of the filtering methods used (it doesn’t contain the keyword of “green port”). But anything related to greening of ports should have been included to the 2020 section because they are the last improvements to be mentioned, and also it is worth mentioning that there are almost no studies about the green port concept in 2020, and it can be related to Covid-19 Pandemic, which keeps the logistics agenda busy. It’s unfortunate to end the review with no improvements in the current year, however the expected studies mentioned at the end of year 2019 section, can be published in the following years.

CHAPTER 3

STUDY ON IMPLEMENTING GREEN PORT STRATEGY

AT THE NEW MANGALORE PORT AUTHORITY

3.1 Introduction

Indian Ocean gains importance due to the fact that global maritime trade of the world's shipping passes through this region. 90% of India's trade by volume and 70 % by value are being traded by means of maritime route. The year 2018 saw an impressive handling capacity of 1451.19 MPTA was a significant one for the Ministry of Shipping. The major ports post an impressive performance in terms of capacity and improvement in efficiency parameters by boosting policy interventions such as the amendment of Model Concession Agreement, revisions on tariff guidelines which are the contributing measures towards simplifying Ease of Doing Business (Bureau, 2018). The recent years past have witnessed a phenomenal growth in port development and trade enrichment. The constructs such as port development, port efficiency, port connectivity and port capacity have been the topic of the day. However, the recent years have witnessed the social importance of environment impact of the port operations and port development. It is envisaged that the Indian Port capacity will increase to 3300 + MMTA by 2025 to cater the growing needs as per studies under Sagarmala Programme which includes construction of new berths, last mile rail infrastructure, dredging, equipment upgrades and digital solutions (Chandoo, 2020). This study was conducted from the year 2016 – 2019 and the proposals are made to implement the green initiatives at NMPA.

3.1.1 Indian Ministry Initiates New Green Project

The need for cleaner port cannot be ruled out in terms for port development and trade growth. The new project of the Ministry of Shipping, namely Project Green Ports, include 12 sub initiatives, which are highly time bound. The initiatives include preparing plans, monitoring the progress, acquiring equipment to counter the effects of environmental pollution and the last being setting up of sewage plants to treat the waste water.

Also, in the pipeline are the initiatives like schemes for energy production from renewable resources with an investment of INR 7.04 billion (USD 104.5 million). Oil spill response facilities are established which ensure harbour water quality (Greenport, 2016). Solar power plants generating a 91.50 MW of solar energy are also planned at the twelve ports. The ports of Kandla and V. O. Chidambaranar will generate 45 MW of wind energy capacity, out of which a 6 MW plant is already being operational at Kandla. These projects will reduce the carbon di

oxide emissions by 136,000 MT annually. Also, there will be an annual reduction in cost of power generation around INR 750 million (Greenport, 2016).

In order to develop solar power projects, Indian Ports Association (IPA) signed a Memorandum of Understanding with Solar Energy Corporation of India in October 2015 (Offshore Energy, 2017). The report states that, out of the 15.20 MW of solar projects already commissioned, the Visakhapatnam port leads the way with 9 MW, while the other ports in which solar projects have been commissioned are Kolkata port with 0.06 MW, New Mangalore port with 5.19 MW, V.O. Chidambaranar port with 0.5 MW, Mumbai port with 0.12 MW, Chennai port with 0.1 MW, Mormugao with 0.24 MW and Jawaharlal Nehru Port Trust (JNPA) with 0.82 MW (Offshore Energy, 2017).

3.1.2. Port of New Mangalore

Mangalore has a long history dating back to the early Christian era. Mangalore is mentioned in the manuscripts of the Great Library of Alexandria, Egypt. The city of Mangalore is situated at the confluence of two rivers the Netravati and Gurpur as highlighted in Roman history. Greek drama also alludes to Mangalore described as Mangala. Ptolemy, the astronomer and famous explorer of the 2nd century makes a mention of Mangalore in his travelogue. During the time of Vijayanagara Empire, Arab traders had established a flourishing trade in silk and spices between Mangalore and West Asia and even now is known

as the Gateway of Karnataka. The old port has its own constraints at the convergence of Gurupur and Nethravathi rivers. In order to meet the growing demand for sea trade the need for new port was felt and thus New Mangalore Port was born.

The Mangalore Harbour Project was set up in the year 1962 with the project works commenced in 1968. It is the 9th major port in India. The New Mangalore Port, was formally inaugurated by Smt. Indira Gandhi, the then Prime Minister of India, on 11th January 1975. NMPA became operational under the Major Port Trust Act 1963 with effect from 1.4.1980, whence the port became a centre of activities for Importers and Exporters of this region. Over the years the Port has grown from the humble beginning of handling less than a lakh tonne of traffic to the present level of handling 39.15 million tonnes during the last financial year 2019-20. The major commodities imported through the Port are POL Crude for MRPL, Cement, coal, fertilizer, edible oil, liquid chemicals, containerized cargo etc. As found in the webpage of the New Mangalore Port Trust, the port is providing all the facilities for handling the cargo of mega Industries like MRPL-ONGC, OMPL, KIOCL, TOTAL GAZ, MCF, HPCL, IOC, UPCL, etc.

3.2 Concept of Green Port

The concept of Green Port development is the integration of the environmentally friendly method of port activities, operations and management (Badurina, et al, 2017). The measures to establish the ecologically green port include, but not restricted to, policies to reduce the carbon footprints, strategic landscape planning to plant trees and greens to absorb the carbon emissions, fabricating and installing equipment for renewable energy generation, recycling and reuse of materials, and planning for green growth (Badurina, et al, 2017). Every port has its own sustainability issue (Tull, 2006). The sustainability challenges for various ports are diverse, since the environments, geographical locations, capacity of the port, etc. are different, are ghettoized to in-port operations, maritime activities, and in-land transport. The technology requirement and implementation for measurement and reduction of carbon footprints, requirement and implementation of projects related to increase the potentials of ports, without compromising the environmental safety are also challenges for going green in a port (Tull, 2006).

The noteworthy environmental aspects identified in sea ports are,

- (1) emissions to air (including gases, solid particles, and energy; dust is a significant contribution)
- (2) discharges to water (e.g., waste waters, accidental releases during loading/unloading operations)
- (3) releases to soil due essentially to industrial activities
- (4) releases to marine sediments and activities affecting the seabed (such as dredging)
- (5) noise (with its potential impact on population and fauna)
- (6) waste generation and dredging disposal
- (7) loss/degradation of terrestrial habitats
- (8) changes in marine ecosystems
- (9) odours
- (10) resource consumption and
- (11) port development (land and sea occupation) (Darbra et al., 2005).

The top ten environmental priorities identified from the environmental aspects are

- (1) ship waste (sewage)
- (2) noise
- (3) dust
- (4) dredging (disposal)
- (5) port development (land)
- (6) conservation areas
- (7) ballast water
- (8) ship exhaust emission
- (9) energy consumption and
- (10) relationship with local community.

(Klopott, 2013) This warrants diverse researches to be carried out on different green port issues (Darbra et al, 2005); (Peris-Mora et al., 2005); (Tull, 2006); (Klopott, 2013).

Upon reviewing academic papers, environmental documents, white papers released by port authorities for green port, 12 types of green port measures were identified and grouped into five dimensions, namely, environmental quality, use of energy and resource, waste handling, habitat quality, and greenery, as well as social participation (Chui et al, 2014). For a period of 3 years, the priority for the port measures have remained same, from 2017 through 2019. However, the relative priorities changed with climate change (Badurina et al, 2017). Since 2016, air quality and energy consumption are ranked the first and second positions respectively (UNCTAD, 2018). While air quality is treated with topmost environmental priority by the European port sector as a whole, waste management/port management is of high priority to environmental protection in the port sector. Energy consumption had maintained its consistency in second position since 2016. Dredging, port development and dust are constantly appearing in the top 10 priorities of the European seaports in the last 17-18 years. The Environmental Report 2019(Fig.1), published by Ecoports.com has revealed the top 10 priorities for a green port, encapsulated from 1996-2019. Different items of priority are presented in different colours, with a few of them recurring in the consecutive years (E.g., Energy consumption), a few reappearing after a few years(E.g., Water quality – present in 1996, and reappearing in 2013), and so on.

3.2.1 Implementation of Green Port Initiatives – Case of New Mangalore Port

A Green Port is known as an ecological port, since it represents the model of a sustainable port development, which not only meet demands of the environment but also increases the port's economic interests (Badurina et al, 2017). Construction of any new port must include and include its green initiative right from the Detailed Project Report Formulation stage, with a synchronized approach for Ports development. Though the environmental resources are minimal, they constitute the basis for economic development. The term Green port is essential for ports development planning, where acquisition and implementation of improved technology for designing energy efficiency systems (technological innovation, new innovated equipment, etc.) to ensure environmental protection and sustainable economic development are formulated (Badurina et al, 2017).

3.2.2 Green Port Tools, Technologies and Measures at New Mangalore Port

Over the years, the discussion on consolidation of the multiple measures to be defined under the term green ports, has witnessed a paradigm shift from discussing relatively narrow measures like waste management to a broader mainstream measure like management protocols. Earlier the discussions concentrated on waste management at ports, water quality after port operations, or noise reduction happening due to port operations.

The current discussions are stirring towards three categories:

- (1) Technical Infrastructures;
- (2) Pricing and Access and
- (3) Environment Management approaches.

3.3 Technical Infrastructure

The following are the major key points that are proposed, in connection with the implementation of technical infrastructures are on specific problem areas such as energy efficiency, air quality and transitions and ship waste post operations.

3.3.1 Cold Ironing

Cold ironing or onshore power supply is the land-ship technology for providing electricity connection to ships, with power generated from the tertiary sources like wind, water and solar energy. Ships receive this onshore power supply and turn off their diesel engine power

generators (Tseng, 2015), which substantially reduces the greenhouse gas emissions at ports (Winnes, 2015), thereby contributing to the reduction of carbon footprints (Fenton,2017).

3.3.2 Waste Reception Infrastructure

Humans do not understand that marine debris created by them is a major environmental challenge (Ball, 1999); (Sage-Fuller, 2018); (Salomon, & Markus, 2018). The port waste reception facility enables collection of its oily sludge, on-board generated garbage, and all other forms of waste of the ship. The ballast water is also collected by port authorities, with due care taken not to endanger the living species. The measures involve shifting the use of vehicles using fossil fuels to electric vehicles, operating on power generated by renewable resources. A shift towards automation of port operation and management systems into paperless execution is on due.

3.3.3 Greenhouse Gas Emission Inventory

This specific tool is required to maintain a structured inventory on carbon emissions generated due to the use of energy and fuel, track and identify areas to reduce them, thereby improving green power consumption and improved port operations (Mamatok & Jin, 2017).

3.3.4 Pricing and Access mechanism

This mechanism is proposed to gear up the greener operations towards gaining access to terminals by ships and easy business operations for companies operating at the port. The following are the key points:

Environment Shaping Index: ESI is a web-based tool that provides incentives for ships emitting lower greenhouse gas emissions, whereas the ship owners are instructed to submit their fuel receipts to crosscheck the original use of fuels (Lister, Poulsen, & Ponte, 2015). Concession agreements: According to Notteboom, environmental sustainability is made a requirement for granting concessions to companies that want to operate at the port. Concession agreement addresses various issues ranging from the issue of waste and energy to emission reductionll (Notteboom & Lam, 2018).

Port Dues: A stick pricing as the stick‘ and carrot incentive pricing approach have been used by Port authorities to reduce pollution and improve the environmental performance of port users and developers. Port authorities levy surcharges on docking fees and penalize the ships on oil spillage and dock wastes. This tool lays fees or port charges to facilitate the conservation and protection of non-renewable resources (Freeman & Kolstad, 2006).

3.3.5 Environmental Management Systems (EMS)

This is one of the integrated management approaches. For example, based on an internationally recognized policies, environmental management standards are considered as a priority green port tool (Puig et al, 2015). Using this tool, port authorities should devise a strategic plan clearly stating their legal requirements for operational regularisation, objectives for environmental policy, environmental aspects of their operations, and their mitigating programs and initiatives (ESPO, 2016). Another integrated management tool identifies locations to relocate the greenery if any unavoidable impacts are caused due to port construction and thereby practice the port environment mitigation activities (ESPO & Guide, G.2012). Establishment of special departments to handle environmental issues, provide training and development programs to upskill staff to handle new environmental management processes, and also to adopt collaborative mechanisms along with the internal and external stakeholders in implementing environmental policy (von Bargen et al., 2014).

3.4 Research Methodology

This research work explores the sustainability transition of the NMPA port since 2016. The secondary data that was readily available from the open sources such Administrative Report from NMPA web site was used to draw the outcome of implementation of Green Initiatives. The information gathered from literature reviews and document analysis was used to infer the output of the port in terms of environment management strategy. In addition, port officials were flagged to semi-structured interview. A content analysis approach was used to identify the common and divergent themes(Hsieh & Shannon, 2005); (Silverman, 2015).

3.5 Result and Discussion

The greening practice adopted by the port which is ISO certified ISO 9001:2015, ISO 14001:2015 & ISPS Compliant Port viz specific factors Technology Infrastructure, Pricing and Access and Environment management practices influences the measures and tools that of port authorities. The Port specializes in handling mainly general cargo and bulk commodities, container ships, and also handles specialized ships.

Since 2009, NMPA developed and published its Greenport's Sustainability Strategy, for implementing the green port idea, which links the major aspects of economic, ecological and social concerns, to reduce carbon footprints, thereby improving social infrastructure. The Office for Environment and Sustainability affairs was setup, with its director being entrusted with a key role on the management board of the port. Achieving sustainability in a win-win fashion by

fortifying the management policies and plans into the regular port operations is the implicit motto of establishing the office. NMPA was proactive in port operations concerned with managing waste, disposing the dredged materials to prevent marine pollution, ensuring nature protection. Since 2016, energy efficiency took importance in top ranking.

3.5.1. List of Broad Initiatives since 2016 by NMPA

The ever-increasing demand for energy, dwindling fossil fuels and environmental concerns has led to deployment of renewable energy projects throughout the globe. The solar power is one of the renewable energies generated from the conversion of sunlight into electricity directly using Photovoltaic Cells. The Solar Power has numerous benefits over conventional power specially having zero emission and minimum maintenance.

SI No	Details of Solar plant	Capacity	Date of Commissioning	Total Cost Rs Capital Cost + O&M Charges for 10 years) in Cr
(a)	Administrative building, MNPA Hospital & VIP House Guest House/ZCISF barrack	350 KW	April 2016	3.34
(b)	NMPA Colony	4 MW	Dec 2016	24.44
(c)	Wharf – Storage Sheds	840KW	Dec 2017	5.57
	Total Cost for 5.19 MW			33.35

Table 2 Cost of fabricating the solar plants

Source: International Journal of Management

NMPA receives Electrical Power from 33 KV Network of Mangalore Electricity Supply Company MESCOM with a contract demand of 2.5 MVA and an average annual consumption

of 80 Lakhs Units. The total power generated from the date of commissioning is 25.44 M units. The cost saving is Rs 0.17 Cr and the diesel saved 0.350 Litre/day which equals to 8905 KL. Post installation of solar power plant the carbon foot print reduction is 21628 Tonnes i.e. (0.85 Kg/Kwh). The port also provides shore supply to small vessels. Vessels can draw power from the shore to meet their power requirement when berthed. This shall result in non-operation of the vessel DG sets which are stationed which are at berth thereby reducing pollution and carbon emission. In addition, to the Green Port Initiatives the following measures have also been taken to reduce power consumption: -

- Conversion of conventional light fittings to LED light fittings at Adm Bldg, NMPA Hospital, Traffic Bldg, Street Lights etc.
- Installation of 30 M heights High mast lights with LED light fittings first of its in Major Imports.
- Replacements of Old AC & Water Cooler with energy efficient star rated units. As on 31 Mar 2020, With Green Port initiatives, Port has achieved the following: -
 - Total Units a generated from Solar Power Plants – 24 .15 Mn units
 - Total Carbon foot print reduction – 22,000 Tonnes Approx.
 - Total fuel savings – 8905 KL
 - Total amount saved in Electricity bills – Rs 17 Crores.

On analysis of power generation/consumption data for the year 2018-19, it was observed that port has drawn around 5.6 lakh units in excess of energy injected to the MESCOM grid. It was also observed that, energy consumption of MRPL, coastal terminal who is the lone HT power consumer of port was around 5.7 lakhs units during the year 2018-19. Hence, to achieve 100% solarisation, MRPL, Coastal Terminal was requested to avail the power to their costal terminal directly from MESCOM as done by other HT consumer like m/s HPCL, M/s Total Gas since the MESCOM power line is readily available in the vicinity. After continuous persuasion m/s MRPL have availed power to their coastal terminal directly from MESCOM. Thus, by optimising and streamlining of Ports Power Supply System NMPA has achieved 100% Solarisation.

3.5.2. Environment Dimension of NMPA

NMPT Port is anticipated to become a Garden Portl. Such an initiative has embarked on he greening of the operations in the port, which will reinforce the economic sustainability and social sustainability as well. Thus, environmental consciousness is not ornamental to the port, but an essential component to be included into its daily activities.

Biodiversity and conservation: The port aims to preserve trees and the local biodiversity to protect the coastal ecosystem and the climate related risks. An obvious reduction of 2-3^o C in the temperature was felt as a result of this activity of conserving the trees around.

Water Management: Water resources are limited and hence must be consumed in a cautious manner. NMPA Port has devised such a policy that water management is carried out through Smart, Wise and Green acts.

Waste management: This is achieved by treating the sewage in the treatment plants to recycle about 60-70 per cent of used water.

Energy emissions: Emissions are caused from coal conveyor belts, inter-carting, railway sidings till storage yards, edible oil pipelines, electrified railway lines, electrified cranes etc. Methods are under plan to control such emissions.

Environmental Consciousness: Van Mahotsav, an annual programme is conducted by the port to create green awareness and makes employees to plant saplings and continue to take care of them.

3.6 Conclusion

New Mangalore Port has implemented measures intended to address energy efficiency, air quality, renewable resources for power generation and climate change mitigation. Port authorities understand the importance of adopting possible combination of measures to counter the major challenges of imposing regulations, pressing environmental issues, fiscal policies, etc. In an extensive perception, the outcomes substantiate a report by PIANC, which distinguishes that for an economic stability of port the sustainability is only option in long run. The impetus on green port idea, translates it into a business reality. It is in time and place that the (1) Technical Infrastructures; (2) Pricing and Access and (3) Environment Management approaches implemented make sense. To obtain such defined goals the ports must incorporate environmental planning into their development plans. Ports are aplenty with places like walls, open surfaces, backwaters and breakwaters, and a few other infrastructural points where renewable energy generators could be deployed. This disposition sources very little environmental disturbances compared to off-shore or on-shore deployment. Hence, NMPT Port is proving to be a standing example for maintaining a consistent sustainable economic growth by incorporating their environmental and social objectives as one with the business objectives. Green Port Initiatives include, installation of dust suppression systems, installation of equipment to monitor environmental pollution, sourcing energy generating projects from

renewable energy resources, fabricating sewage treatment plants, installing garbage incinerating plants, rectification of shortfalls of Oil Spill Response (OSR) facilities, prevention of garbage disposal at sea, refining the quality of recycling harbour wastes etc.

NMPA aims to augment social development, Economic growth and Environmental protection- that ensures a better quality of life for all as a whole. Infrastructural developments supporting green initiatives and their associated operations will help benchmarking the international trade, and in turn the economic development of countries, which in turn will improve the direct and indirect employability. Challenges relating to compliances of legal requirements, environmental issues, must be aligned with the commercial and social objectives. The sustainability concepts must be implemented in port designing, investments, business models, CSR activities and infrastructure planning. Thus NMPA strives to strike a balance between its economic objectives and social responsibilities.

The alternative renewable sources for energy generation like wind, solar, and water energy have been evaluated and the findings are promising that the energy generated from the renewable resources are reliable for the port's needs. The challenge is there, now it's time for the engineers (civil, marine, etc) to set the conditions and to find the best suitable solutions for the implementation of these technologies in ports. We should encourage our port administrations together with governments to launch more financial tools in order to achieve the target to reduce the emissions from maritime transport and from port logistics.

CHAPTER 4

GREEN PORT GOVERNANCE

4.1 Introduction

Green port governance is a term used to describe the set of policies, regulations, and practices aimed at promoting environmental sustainability and reducing the carbon footprint of ports and the maritime industry. The concept is relatively new, and its implementation varies depending on the port's size, location, and type of cargo handled. However, there are common themes that run through most green port governance frameworks, such as environmental management systems (EMS), energy efficiency, emissions reduction, waste management, and collaboration and stakeholder engagement.

Environmental management systems (EMS) are a systematic approach to managing environmental impacts. An EMS is designed to identify, evaluate, and manage the environmental risks and impacts of port activities, including the handling of cargo, waste management, and energy consumption. EMSs can help ports reduce their environmental impact by identifying areas for improvement, setting targets for reducing their carbon footprint, and monitoring their progress.

Energy efficiency is one of the primary goals of green port governance. Ports are significant consumers of energy, and reducing their energy consumption can help reduce greenhouse gas emissions. This can be achieved through the use of energy-efficient technologies, such as LED lighting, and the development of onshore power supply systems that allow ships to switch off their engines while in port. The use of renewable energy sources, such as solar and wind power, is also becoming increasingly popular in some ports.

Emissions reduction is another critical goal of green port governance. The maritime industry is a significant contributor to global greenhouse gas emissions, and reducing emissions from ports and ships can help mitigate climate change. This can be achieved through the adoption of low-emission fuels, such as liquefied natural gas (LNG) and hydrogen, and the use of emissions control technologies, such as exhaust gas scrubbers. Many ports are also implementing measures to reduce emissions from port equipment, such as cranes and trucks.

Waste management is another area of focus for green port governance. Port activities generate significant amounts of waste, including solid waste, wastewater, and hazardous waste. Green port governance frameworks aim to reduce the environmental impact of waste by promoting waste reduction, recycling, and proper disposal. Many ports have implemented waste

management plans that focus on reducing the amount of waste generated and promoting recycling and reuse.

Collaboration and stakeholder engagement are essential components of green port governance. Ports are complex systems that involve a wide range of stakeholders, including port authorities, shipping lines, cargo owners, and local communities. Effective collaboration and stakeholder engagement are essential to the success of green port governance initiatives. Many ports are working closely with their stakeholders to develop and implement green port governance frameworks that meet the needs of all parties involved.

Implementing green port governance requires a combination of regulatory and voluntary measures. Governments can play a critical role in promoting green port governance by introducing regulations and incentives that encourage the adoption of environmentally sustainable practices. For example, some countries have introduced port emission regulations that require ships to use low-emission fuels and technologies while in port. Other countries have implemented tax incentives to encourage the adoption of renewable energy sources in ports.

Ports can also take voluntary measures to promote green port governance. Many ports are participating in industry-led initiatives, such as the Green Marine program in North America, which is a voluntary environmental certification program for the maritime industry. The Green Port initiative in Europe is another example of a voluntary program aimed at promoting environmental sustainability in ports.

green port governance is essential in the face of the growing threat of climate change and the urgent need to reduce greenhouse gas emissions. Effective green port governance requires the involvement of a wide range of stakeholders and a combination of regulatory and voluntary measures.

4.2 Port Authorities and Green Ports

Port authorities play a critical role in promoting green ports. As the governing bodies responsible for the management and operation of ports, they have a significant influence on the environmental impact of port activities. Green ports are those that adopt environmentally sustainable practices and technologies, reducing their carbon footprint and promoting environmental stewardship. The adoption of green port governance frameworks by port authorities can have a significant impact on the environment and the communities that surround ports.

One of the key roles of port authorities in promoting green ports is to develop and implement environmental policies and strategies. Port authorities can develop policies that encourage the adoption of environmentally sustainable practices, such as reducing emissions from port equipment, promoting the use of renewable energy sources, and implementing waste management plans. They can also set targets for reducing greenhouse gas emissions and monitor progress towards achieving these targets.

Another critical role of port authorities is to regulate port activities to ensure compliance with environmental standards and regulations. They can develop and enforce regulations that require ships to use low-emission fuels and technologies while in port, promote the use of onshore power supply systems, and implement emissions control technologies, such as exhaust gas scrubbers. These regulations can have a significant impact on reducing the environmental impact of port activities.

Port authorities can also promote green ports through collaboration and stakeholder engagement. They can work closely with shipping lines, cargo owners, and local communities to develop and implement green port governance frameworks that meet the needs of all parties involved. Collaboration can lead to the development of innovative solutions to environmental challenges and help build support for green port initiatives.

In addition to developing and implementing green port governance frameworks, port authorities can also invest in infrastructure and technology that promotes environmental sustainability. For example, they can develop onshore power supply systems that allow ships to switch off their engines while in port, reducing emissions and noise pollution. They can also invest in renewable energy sources, such as solar and wind power, to power port operations and reduce dependence on fossil fuels.

Port authorities can also promote the use of clean vehicles and equipment in port operations. This can include the use of electric or hybrid trucks and cranes, which can significantly reduce emissions from port activities. They can also promote the use of low-emission fuels, such as biodiesel or hydrogen, in port equipment.

Finally, port authorities can play a role in promoting the circular economy in ports. The circular economy is an economic system that aims to minimize waste and promote the reuse and recycling of materials. Port authorities can work with stakeholders to develop systems for the reuse and recycling of waste generated by port activities, reducing the environmental impact of waste.

port authorities play a critical role in promoting green ports. By developing and implementing green port governance frameworks, regulating port activities, promoting collaboration and stakeholder engagement, investing in infrastructure and technology, promoting clean vehicles and equipment, and promoting the circular economy, port authorities can significantly reduce the environmental impact of port activities and promote environmental sustainability. As the global community continues to face the threat of climate change, the adoption of green port governance frameworks by port authorities is becoming increasingly important.

4.2.1 Sources of Environmental Pollution in Ports

Since ports are generators of externalities, environmental concerns linked to port activity are mounting. The focus on environmental issues is especially keen for vessel and cargo handling operations, industrial activities in ports, port planning, and extension initiatives, and hinterland accessibility. The prime sources of the environmental impact of seaports include pollution related to port-related construction and operations. These include air emissions of ships at berth, terminal handling equipment (such as cranes and yard equipment), and logistics and industrial activities in the port. There is also noise associated with port-related operations and the environmental effects and potential congestion associated with landside operations of barges, rail, and trucks.

There are nine groups of environmental facets in port development and construction, including water quality, coastal hydrology, soil contamination, marine, and coastal ecology, air quality, noise and vibration, waste management, visual intrusion, and socio-cultural impacts such as the relocation of communities. This classification provides possible realms of engagement, mitigation, and policy-making and requires precise measurements of respective impacts and externalities.

Air pollution is one of the major environmental impacts generated by ports, particularly greenhouse gas (GHG) emissions, leading to climate change since GHG traps heat. This, in turn, distorts the natural ecosystem. There are also health effects impacting the residents of the local community surrounding ports which include asthma, other respiratory diseases, cardiovascular disease, lung cancer, and premature mortality. The main sources of air pollution in ports include:

Ships port calls, which are a source of air pollutants such as CO₂, SO_x, NO_x, PM₁₀, PM_{2.5}, HC, CO, and VOC. The maritime shipping industry contributes 2.5% to 3% of annual human-produced carbon dioxide (CO₂) emissions, in which the largest portion is derived from

container shipping. Without countermeasures, the emissions of sulfur oxide (SOx) and nitrogen oxide (NOx) of the shipping industry would exceed all other emission sources in transport and result in poor air quality in ports and their surroundings. To reduce, and eventually halt emissions, some important steps have already been taken. They include the judicial implementation of the International Maritime Organisation (IMO) Convention for the Prevention of Pollution from Ships (MARPOL) (Annex VI) that imposes limitations on the main air pollutants contained in ships exhaust as well as plans for implementing additional requirements, the Energy Efficiency Design Index (EEDI) for new ships, and the Ship Energy Efficiency Management Plan (SEEMP) for all ships. The Convention places a cap on sulfur within particular areas (Emission Control Areas – ECAs). For example, in the SECA (Sulfur Emission Control Area) in the North and Baltic Seas area, the mass fraction of sulfur in bunker fuel has to be less than 1% from 2010. North America installed similar arrangements in 2012. This limit was decreased to less than 0.1% from 2015. The worldwide sulfur limit of 3.5% in bunker fuel was reduced to 0.5% in early 2020. Specific sulfur caps exist when ships are in port. Alternative fuels are considered (Liquefied Natural Gas(LNG), and hydrogen) to reduce ship emissions at sea and in ports. Onshore power supply solutions (or cold ironing) can help to reduce ship emissions in port significantly.

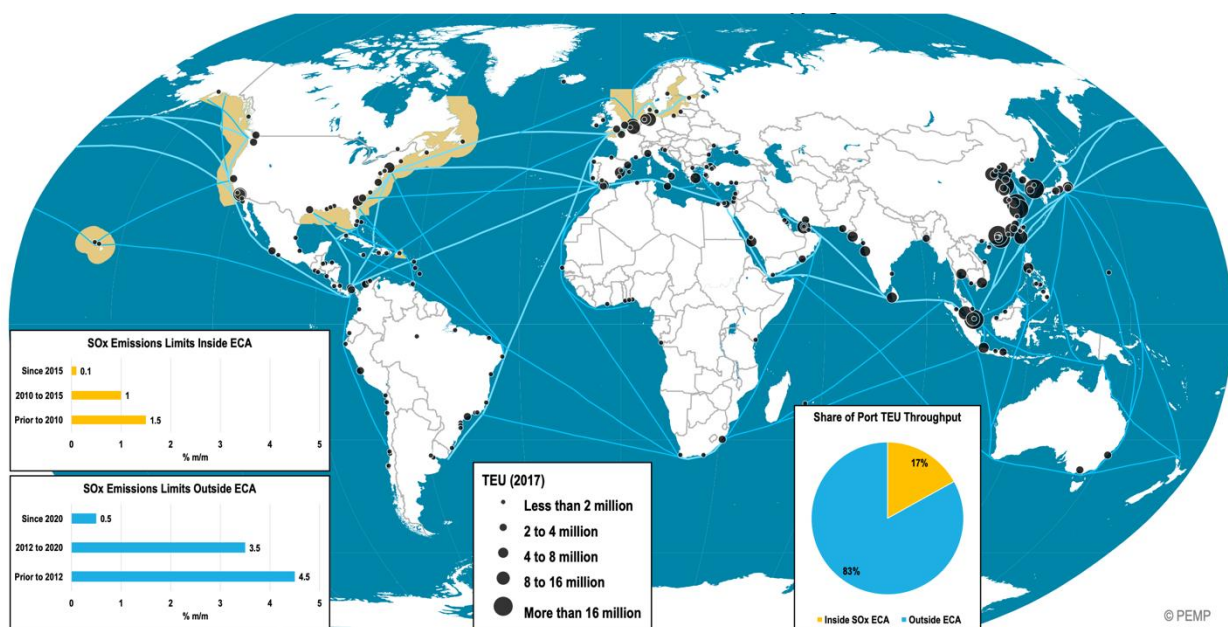


Fig 4.1- Emission Control Areas for Maritime Shipping

Sources: IMO. Marine Institute (VLIZ), Belgium; (2020)

Land side activities, particularly cargo operations at terminals, which form another source of airborne emission. Emissions of dust from bulk cargo handling, electricity consumption, and gases from cargo handling equipment and trucks adversely affect air quality.

Regarding landside operations connecting inland transport, environmental impacts caused by intermodal connections and congestion lead to adverse effects, particularly air pollution emitted by internal combustion engines. Depending on modal choices and the associated cost and transit time requirements from shippers, such environmental effects vary and can be mitigated.

Industrial and logistics activities in and near port areas. These also contribute to total air emissions but tend to be considered outside port emissions.

Another major environmental concern is **water pollution** and its effects on marine ecosystems. Water pollution comes from ballast water, fuel oil residue and waste disposal from ship operations, and cargo residue. These marine pollutants are harmful to natural habitats located around port waters, which would upset marine and coastal ecology and lead to the damage and loss of coastal ecology and fishery resources. The need for navigation channel deepening and widening would lead to contaminated sludge from dredging.

Untreated water and waste disposal from port operations, industrial activities, construction, and expansion projects causes another major category of environmental externality. This includes solid, liquid, and hazardous wastes. Waste lubricants, oily mixtures, solid waste (garbage), wastes from cargo operations, daily administration, and buildings also create pollution. Disposal of these contaminated materials on land may cause destruction of plants, leakage of contaminated materials, unpleasant sights, and other nuisances to the local community. Hence, improper waste control and treatment can be a significant strain on the natural environment surrounding the port area. An international policy agenda has already been developed referring to the availability and adequacy of port reception facilities for ship-generated waste and cargo residues. Together with establishing systems that provide incentives for ships to use, these facilities reduce ship discharges into the sea.

Relevant provisions have been adopted in Annexes V and VI of MARPOL. These provisions define which wastes can be discharged into the sea and impose obligations to provide facilities for the reception of ship-generated residues and garbage. They also avoid inadequate reception and handling and inadequate delivery by ships of their waste cargo residues. Regional initiatives (i.e., the European Union Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues) align legislation with the international initiatives and address the legal, financial, and practical responsibilities of the different operators involved when operating at ports.

Waste management in ports implies a hierarchy containing several steps in a preferred order of priority, with the first three of the following being the most desirable ones:

- **Reducing** the use of resources and minimizing the quantities and hazardous qualities of the waste generated.
- **Reuse**. Using products or items again for the same or different purposes.
- **Recycling**. reprocessing valuable components/materials of waste for use as a feedstock to manufacture the same or a different product.
- **Recovery**. Obtaining value from wastes by composting, energy recovery, or other technologies.
- **Disposal**. If there is no other appropriate solution, waste disposal by land filling and incineration without energy recovery. Waste disposal has various options depending on the type of waste and according to acceptable environmental standards.

Two initial steps allow achieving better results:

- **Waste segregation** separates waste, making it useable or less difficult to dispose of. Waste segregation at source is a prerequisite to securing separate fractions of sufficient quality for different treatment processes.
- **Waste treatment** to reduce hazards or nuisance, preferably at the site of generation. The need for treatment and the level and type of treatment is determined by the requirement of its use or disposal.

4.2.2 The greening of port management

The greening of port management is attracting growing attention in business practice as the growing green reflex is mirrored in the many green initiatives of individual ports and the coordinated actions of the wider port community, Port authorities show increasing concerns about the impacts of noise pollution, waste disposal, water pollution and air emissions on the sustainable functioning of the port since they represent the externalities that have the most identifiable impacts on the health of people working or living around ports. Limiting pollution is not only an environmental goal for port authorities. It has also become a clear mission in corporate social responsibility (CSR) and stake holders relation management in port areas.

It has become evident that any port infrastructure project can be constrained by environmental factors and the public response they can generate. Thus, ports are facing higher pressure from the public in terms of performing their social responsibility. Ports must demonstrate an ever-

higher level of environmental performance to ensure community support. Ports need to comply with ever-higher regulatory and societal requirements in the fields of environmental protection, which can impact the footprint for the ports to grow, not only in terms of hectares but also in terms of so-called environmental space. This challenges seaports to minimize emissions of existing and future activities in the port areas and the wider logistics area. Environmental aspects also play an increasing role in attracting trading partners and potential investors. A port with a strong environmental record and a high level of community support is likely to be favoured.

As such, green port governance is considered a key strategic challenge to port authorities and the wider port communities. Without proper environmental governance, tools and policies in ports, there is an increased risk of having a clear imbalance between the benefits and costs of ports for the local community. Such imbalances potentially form a breeding ground for major socio-economic confrontations related to port development and operations.

4.3 Instruments and Tools for Promoting Green Ports

Given the potential environmental impacts of port development and operations, port authorities or any other managing bodies of a seaport are challenged to avoid and or reduce effects through a range of green management tools and instruments. In the following sections, three groups of tools and instruments are discussed in more detail:

- (a) penalty and incentive pricing,
- (b) monitoring and measuring,
- (c) market access control and environmental standard regulation.

Instruments can also be grouped into two categories, which are instruments that directly limit environmental impacts and instruments that do not. Such a range of instruments in a port terminal context can be used to influence the green behaviour of a terminal operator.

4.3.1 Penalty and Incentive Pricing

Port authorities can use port pricing as an environmental incentive tool in ports. Motivating or giving an incentive pricing to the good doers and punishing or giving a penalty pricing to the wrongdoers is an effective tool to promote environmental awareness. Pricing control by port authorities is most commonly used in shipping traffic, followed by industrial activities at ports.

Voluntary schemes aimed at cleaner ships, such as rewarding the use of low sulfur fuel oil (LSFO), are the most common. A pioneering example is the Port of Long Beach which implemented the Green Flag Speed Reduction Program. By slowing down, ships can reduce airborne emissions, and shipowners, in return, are granted a discount the following year as an incentive.

Another good example is green port dues, such as the Environmental Ship Index (ESI) program. Ship operators typically embrace such voluntary schemes, particularly when the implementation and further refinement/updating of such programs go hand in hand with a proactive and constructive collaboration between the maritime industry and the respective government agencies or port authorities. However, since prices paid by shipping companies and other port users affect their commercial behaviour and decisions, price regulation may lead to market distortions if not uniformly applied among competing ports.

4.3.2 Monitoring and measuring

Ports are highly vulnerable to unfounded claims of environmental damage. To deflect such claims, ports need quantifiable and detailed information on the impacts of their operations on the adjacent environment. Port authorities and wider port communities should communicate how environmental impacts associated with port operations are being effectively managed. By monitoring the air quality, water quality, and policy development, the port authority could keep track of the port's environmental performance, and subsequently formulate or modify its targeted strategies and policies.

Many port authorities have increased transparency on environmental impacts and broader sustainability aspects by publishing annual or bi-annual sustainability reports. The practice of sustainability reporting, beyond mere environmental reporting, started in the late 1990s. More recently, the port industry has adopted this sort of reporting to conceptualize sustainability and as an essential basis for the license to operate. Mainly larger port authorities have started producing sustainability reports or integrated reporting voluntarily in the past decade (e.g. Antwerp, Hamburg, Rotterdam). In contrast, others have been obliged to adopt the practice due to enforced legislation by governments when it comes to example-setting by state-owned enterprises (e.g., Swedish ports). Ports increasingly follow global guidelines and standards for sustainability reporting (such as the Global Reporting Initiative – GRI).

In 2016, the first Sustainability Report at the level of the European Port Industry was presented in the context of the European Commission PORTOPIA project. Using datasets present within

the European Seaports Organisation (ESPO) and the ECOPORTS project, it revealed that many unsolved conceptual issues and differences in approach among ports remain when it comes to sustainability reporting:

- The scope and the boundaries of the reporting, i.e., organizational, functional, or geographical boundaries.
- The perspectives of performance and the calculation/definition of indicators.
- The integration of stakeholder perspectives.

4.3.3 Market Access Control and Environmental Standard Regulation

Access regulation controls how terminal operators and other port actors access the facilities they need to compete in the market. Access regulation can include elements concerning emissions and overall environmental performance. A good example is how environmental criteria can be used in the competitive bidding procedure for a terminal concession.

Port authorities might have varying degrees of regulatory jurisdiction to restrict market access and stipulate environmental standards. In other words, the discretionary powers of port authorities in environmental matters have their limits. In most cases, the bulk of the regulatory power can be found at the regional, national or supranational level. For example, international conventions, like MARPOL, give each signatory nation the accountability to enact domestic laws to implement the convention and to comply with it.

Other than international regulatory control, legislation is at various levels depending on the country/port. It could be a stated law from national government, a law stipulated by the municipality, certain rules set by the port authority (such as the Clean Truck Program for the ports of Los Angeles and Long Beach), or a mutually binding agreement between the port authority and market players such as concession agreements. Although regulations are usually strict, their implementation and enforcement might be slow and weak due to a lack of local legitimacy caused by conflicting interests of stakeholders. They might also come at a high regulation cost for both implementation and enforcement. While the environmental level playing field among ports continues to be considered, attention has shifted to the need to cooperate, both nationally and internationally, to push the green port agenda forward.

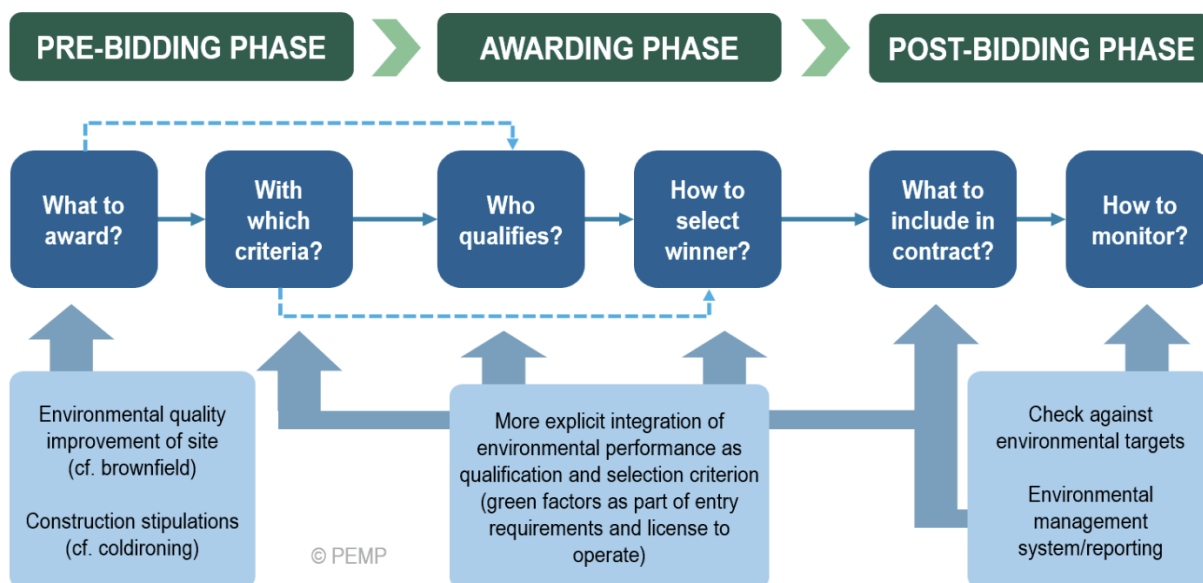


Fig 4.3 The Greening of Terminal Concessions

Sources: IMO. Marine Institute (VLIZ), Belgium; (2020)

When deciding what site to award, port authorities could more explicitly look at the environmental quality of the port site. Brownfields might be more expensive to redevelop but often lead to higher spatial quality and regeneration of older port sites. Port authorities could also include more stringent construction guidelines for port infrastructure and superstructure. Such measures could include using a minimum percentage of green energy or the installation of cold ironing facilities.

4.4 Challenges to Green Port Governance

Port authorities have realized that further greening is required to maintain their competitive edge and their license to operate, but it can also create **earning opportunities**. In practice, the attitude of port authorities can range from **reactive monitoring** of general environmental management programs to more **proactive approaches** aimed at value creation and revenue-making.

However, port communities also understand that the **challenges remain immense** and progress made is not at the same level in all domains of action:

- Reducing the environmental footprint commonly requires **drastic and large-scale solutions** such as Carbon Capture and Utilization (CCU) and Carbon Capture and Storage (CCS), a further push towards greener shipping and modal shift.
- The greening of ports also demands a shift in **perspectives, values, and a joint commitment and dedication** of the parties involved. More than ever, port authorities

and market players will have to call out to other partners in the chains to achieve green corporate and societal objectives. Success typically depends on coordination and cooperation **between the involved actors** and the availability, use, and **sharing of data** through appropriate platforms and systems.

- As many landlord port authorities have been corporatized, **investment recovery** is often cited as a critical aspect of green initiatives.



Fig 4.4 - Carbon capture utilisation and storage

Like private companies, port authorities have become very sensitive to the coherence, continuity, and legal certainty of developed government policies. As many investment decisions have a medium to long-term payback time, any changes in government policy can have huge implications for the soundness of the initial decision related to a green initiative. This is particularly the case for the abolition of a subsidy scheme for specific green investments. Thus, government policies and regulations should provide legal and investment certainty to the affected port authorities and private businesses.

Instead of opting for a one size fits all approach in environmental initiatives, landlord port authorities are invited to evaluate carefully:

- Whether they have a role to play, such as will their involvement likely lead to a superior outcome compared to no involvement?

- What tools or instruments to use, such as pricing, knowledge development/sharing, and investment?
- Whether they should act as facilitators or entrepreneurs. In some cases, port authorities move beyond the pure facilitation role by entering into key investments, particularly when private investors show more reluctance to do so.

While many port authorities are very active in implementing the green port concept, progress remains difficult in some areas, such as the large-scale implementation of cold ironing solutions for deep-sea vessels, or the greening of terminal concession procedures and agreements.

Given the position of seaports as key nodes in global supply chains and logistics networks, it is tempting to push port authorities to take up a role as tax collectors for the related environmental damage. Policymakers should not force port authorities to act as the convenient tax collectors for greening supply chains at the supranational or national level. Any internalization of environmental costs should target the polluter at source and cannot lead to an obligation for port authorities to punish for externalities or to reward environmental performance. Obviously, the above point does not imply that port authorities should refrain from launching such schemes on a voluntary basis, either individually or in collaboration with other ports.

4.5 Green Port Governance and Stakeholders

Stakeholder relations management has become an important part of port management and strategy . In dealing with stakeholders, port authorities can resort to effective environmental management, which includes:

- An **environmental management system**. In essence, this is a documented process that describes a structure for the management of environmental impact processes and continuous improvements, such as environmental risk assessment and management actions to address those risks.
- **Environmental monitoring and reporting**. Ports are extremely vulnerable to unfounded claims of environmental damage, such as those related to dredging. To deflect such claims, ports need quantifiable and detailed information on the environmental impacts of their operations. Examples of environmental reporting are environmental impact assessment studies associated with port expansion, reports related to dredging impacts, and monitoring of natural resources such as wetland conditions and bird populations, and migration. A growing number of ports are developing sustainability reports on an annual or regular basis.

- **Community consultation** forms a key component of environmental management. Ports should communicate how environmental impacts associated with port operations are being effectively managed. If a port starts a dialogue with the local community only in response to a problem, a negative perception in the community could be the outcome. The key is to identify what aspects of port development are negotiable and then communicate this to the community.
- **Land use strategies** should identify plans for future port operation and strategies to conserve and protect conservation value areas, such as buffers and wildlife corridors. By coming to terms with both the community and the government on future port activities, a port can reach a higher level of certainty that it will grow and meet changing trade needs.

When ecosystems are damaged or lost due to port development, port authorities should interact with stakeholders to find answers to some important questions about the restoration of environmental assets:

- What is to be restored; the resource itself or resource services?
- How much restoration is required to compensate for the loss?
- What alternative does the cost-effective restoration option provide?
- Do the benefits to be obtained from the restoration justify the costs?
- Who pays, or how can the costs be shared equitably?

These questions raise real concerns for green port governance as mitigation and compensation measures can add between 10% and 20% to the port project cost.

4.6 Green Cruise Ports

Not only cargo ports are challenged to **reduce environmental impacts**. The aspirations to host more cruise activities are increasingly combined with the strategic importance of sustainability and green cruise governance. To a great extent, this combination is, ironically, founded on achieving already remarkable growth.

4.5.1 The cruise environmental challenge

The gigantism of cruise ships and the multiplication of cruise itineraries implies an increased number of passengers arriving at a destination with one call alone, posing significant challenges on cruise ports and destinations hosting them. The contemporary cruise segment of the sector,

which represents more than 75% of cruises, is offered by vessels that exceed the 3,000 passengers and 1,000 crew threshold. This implies the mass arrivals of tourists at local destinations, concerns for overcrowding, congestion, massive operations, considerable footprint, and needs for receiving quantities of waste. Justifiably or not, local communities have started questioning the unqualified growth of cruising, which had for long been taken as a beneficial development. While the benefits, in terms of spending at destinations, are profound, this growth might be associated with congestion and several related externalities to be addressed.

A condition to enable local communities to extract the greatest benefit from cruise market growth is the endorsement of best practices and policy options to mitigate the externalities produced by cruise shipping. The challenges to be addressed relate to three pillars, one of them referring to the environment. Addressing the externalities produced by the provision of cruise shipping and the hosting of vessels and cruise passengers at cruise ports stands today as a priority. Environmental externalities refer to the handling of waste produced, water quality, air emissions, noise, and soil, as well as to other issues (i.e., constructions that alter natural or built environment, fauna, energy resources). Two key externalities are waste management and the various forms of emissions, including air and noise emissions. Their importance and global presence have led to discussion and conclusions on measures to occur at the international level.

4.5.2 Waste management

A key issue on cruising and the environment is developing effective policies and practices for collecting and handling the waste and garbage produced onboard. As a cruise ship carries several thousand passengers and crew in an enclosed facility, an array of municipal utilities such as water supply, electricity generation, sewers, and waste management are found onboard. The amount and types of waste might vary from one cruise ship to another, yet cruises are generators of the highest amount of garbage compared to other shipping markets. A cruise ship with 3,000 passengers and crew generates about 50 tons of solid waste in a single week and an average of 50 tons of sewage (black water) per day. IMO uses a figure of 3.5 kg/passenger/day, while the US Department of Transportation data estimates that the generated waste during a typical one-week voyage includes 25,000 gallons of oily bilge water; 210,000 gallons of sewage (or black water), one million gallons of non-sewage wastewater and eight tons of solid waste (i.e., plastic, paper, wood, cardboard, food, cans, glass).

Most cruise lines and port authorities have implemented environmental management systems to ensure improved **waste reception operations**. Cruise lines have put effort into reducing,

selecting, and managing the garbage generated onboard in compliance with MARPOL requirements. An environmental policy goal of ‘zero discharge’ for solid waste at sea has been endorsed by several of them, putting pressure on cruise ports to go beyond the environmental regulatory obligations. Waste management at the port is vital, as is shipboard recycling, oil wastes treatment, management of hazardous wastes, and ballast water management for cruise companies. Similarly, cruise ports implement solid waste management processes. They develop facilities, technologies, and services to allow for continuity in a cruise ship’s garbage life cycle that is more efficient. Today, port reception facilities are generally available, and the volumes of waste delivered, compared to that discharged at sea, have increased.

A significant concern for cruise ports, operators, and involved third parties is developing efficient information and monitoring systems allowing for the best use of the mechanisms present. Reducing solid waste and increasing recycling via the availability of garbage reception facilities at all berths, 24 hours a day, seven days per week, demands stakeholders’ cooperation to manage better ship-generated waste and, not least, the application of innovative technologies. Cruise ports need to promote handling services such as segregation, biological reprocessing, inactivation and composting, recycling, and storage. Together, these actors can explore waste treatment possibilities on ships via investment in advancing innovative new technologies. These efforts could decrease the significant disparity between waste management ashore and disposal services at the destination.

Improving wastewater treatment capacities is a process of importance. In this case, the IMO has already designated special areas for passenger ships (i.e., the Baltic sea) where the discharge of sewage from a cruise ship will be prohibited through a gradual process. Stakeholders undertake initiatives to ensure that facilities for the reception of sewage are provided in ports and terminals where coastal countries can report that the sewage reception facilities in their ports fulfil the criteria of adequacy.

4.5.3 Emission control

Cruise port and cruise shipping-related emissions have attracted great interest among decision-makers and in port-cities that experience port and port-related operations’ negative externalities. Cruise shipping is a relatively large emitter due to the large hoteling load. Even though the average emissions in a port account are comparatively low, cruise terminals are often close to city centres, meaning that population exposure might be on the higher side. Significant differences in CO₂ emissions can be observed between individual cruise ships depending on the size, the age, and the ship’s capacity configuration (i.e., high-end luxury cruise ships vs. mass

cruise ships). The largest ships show the lowest CO₂ output partly because of the high occupancy rate in the number of beds per surface unit and their relatively young age.

The need to control emissions, along with the international regulatory frameworks restricting the use of fuelling options, has triggered interest in alternative forms of powering cruise vessels. Liquefied Natural Gas (LNG) has emerged as the primary alternative fuel for the shipping industry as many new buildings have dual-fuel engines that allow them to use heavy oil or LNG. Cruise ships have the highest adoption build rate among the different types of seagoing vessels; LNG will power 19 out of 105 cruise ships to be delivered between 2018 and 2026, and more cruise lines are committing to LNG-fuelled cruise ships. This increase creates for the cruise port industry the need for the provision of LNG bunkering facilities. Cruise ports can also use LNG to fuel their handling and transport equipment and serve the energy needs of the cruise terminal buildings, such as air conditioning. Cold ironing or shoreside power facilities are also installed in several urban cruise terminals to reduce the environmental impact of docked ships.

The application of measures to reduce emissions, including onshore power for cruise ships, remains subject to regional variations. For example, it is further developed in North America than in Europe, with future technologies, such as wind and solar power, also options under consideration.

Regarding noise emissions, there are different noise sources on ships during their dockage at ports, classified as diesel generator engine exhaust, ventilation inlets/outlets, and secondary noise sources, e.g., pumps or reefers. Cruise ship operations generate disturbing noise for nearby areas and the crew, and they are also sources of low-frequency noises. The IMO has already defined a Code on noise levels on board ships detailing limits for the different types of noise and set limits for the noise emitted into the surroundings. However, the existing international framework covers only the noise onboard ships but not in a port or during manoeuvring. While the latter activities are in some countries subject to additional regulations, an international discussion for global rules would facilitate an effective and sustaining answer concerning the limits of noise emissions produced by cruise vessels at the port.

4.5.4 Regulating an Emerging Industry

In environmental challenges, international regulations are highly appropriate when a legislative approach is found wanting. The most appropriate way to deal with environmental externalities uniformly, hence securing a level playing field for the entire cruise industry, is the endorsement

of international policy instruments. In the significant parts of the market (i.e., North America, Europe), legislation is already endorsed as the main driver of the need for environmental management tools. In emerging areas, such as Asia, environmental considerations remain for the moment of secondary importance. Beyond legislation, agreements on associated issues – such as the presence of remote monitoring systems as tools for improving the level of cruise and port environmental conditions – which demand complex and expensive processes are better addressed at the international level, rather than being causes of distorting competition.

The industry has implemented several self-regulatory practices that have secured growth and remarkable operational achievements. Even on the environmental front, self-regulation at the international level is not rare. Cruise companies spend heavily to install exhaust gas cleaning technology (scrubbers) to reduce air emissions from cruise ships. Receiving support from governmental organizations (i.e. Carnival has established links with the US Coast Guard and Transport Canada on this issue, while Royal Caribbean International has developed similar initiatives) and through discussion would help develop and implement environmental technology to comply with existing regulation or even pre-empt future ones. Cooperation aims to advance innovation and alternative approaches at the international level to facilitate adjustments and solutions meeting the challenges related to shore power for cruise ships. Similarly, meaningful international cruise emissions inventories would provide information on several unknown factors, such as the actual emissions of ships while docked compared with when they are at sea or comparison with emissions from other shipping sectors. All these would inform adjustments of the related regulatory frameworks.

Environmental externalities have been the theme of initiatives collectively developed by the port industry within respective port associations. Individual ports use environmental management systems compliant with ISO14001 and other practices and tools available to manage environmental issues. Incentive pricing is also applied as a means to address environmental challenges. Ships producing reduced quantities of ship-generated waste are subject to lower dues, as discounts are offered based on green award certificates or the basis of an environmental ship index. However, even in this case, the presence of common principles would facilitate the identification of such ships. Simultaneously, it would limit questions on the effectiveness of the tools in application, and not least the potential for cross-subsidization between ship types depending on the markets served.

Overall environmental issues regarding cruise shipping and those regarding cruise ports are strongly interconnected. Thus the tools, measures, and policies to combat the externalities

caused by these two industries require a holistic study and approach to be developed internationally. Reports, studies, and essential inventories of internalizing external costs are another field beyond regulation that international level discussions might advance, facilitating the growth of cruise activities.

4.6 Conclusion

Green Port Governance is an essential concept for promoting sustainable port operations and reducing the environmental impact of port activities. The study of various green port initiatives across the world has revealed that port authorities play a crucial role in promoting green ports through the adoption of green port governance frameworks.

The findings of this study highlight that the implementation of green port governance frameworks requires a coordinated effort from multiple stakeholders, including port authorities, shipping lines, cargo owners, and local communities. Effective green port governance frameworks involve the adoption of policies and strategies that encourage the use of environmentally sustainable practices, such as the reduction of greenhouse gas emissions, implementation of waste management plans, and use of renewable energy sources.

Moreover, the study suggests that port authorities can promote green ports through the development and enforcement of regulations that require ships to use low-emission fuels and technologies while in port. Additionally, the promotion of collaboration and stakeholder engagement can help build support for green port initiatives, leading to the development of innovative solutions to environmental challenges.

Investing in infrastructure and technology that promotes environmental sustainability is another crucial aspect of green port governance. The development of onshore power supply systems, renewable energy sources, and clean vehicles and equipment can significantly reduce the environmental impact of port activities. Moreover, promoting the circular economy in ports by developing systems for the reuse and recycling of waste generated by port activities can also contribute to reducing the environmental impact of port operations.

The findings of this study highlight the importance of green port governance in promoting sustainable port operations and reducing the environmental impact of port activities. Port authorities play a crucial role in the implementation of green port governance frameworks through the development of policies and strategies, regulations, collaboration, and stakeholder engagement. Investment in infrastructure and technology that promotes environmental

sustainability and the promotion of circular economy initiatives can significantly reduce the environmental impact of port activities.

As the global community faces the threat of climate change, the implementation of green port governance frameworks by port authorities becomes increasingly important. The adoption of environmentally sustainable practices in port operations not only reduces the carbon footprint of port activities but also promotes environmental stewardship and contributes to the achievement of global climate goals.

Therefore, it is recommended that port authorities worldwide prioritize the adoption of green port governance frameworks and collaborate with other stakeholders to promote sustainable port operations. Governments and international organizations can also play a crucial role in supporting the adoption of green port governance frameworks by providing incentives, funding, and technical assistance to port authorities.

In conclusion, the implementation of green port governance frameworks requires a concerted effort from multiple stakeholders and a long-term commitment to promoting sustainable port operations. Port authorities, as the governing bodies responsible for the management and operation of ports, have a critical role to play in promoting green ports and reducing the environmental impact of port activities. By adopting green port governance frameworks, port authorities can lead the way towards a sustainable future for the global maritime industry.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

The study on green port strategies of New Mangalore Port Authority (NMPA) highlights the efforts and initiatives taken by the port authority to promote sustainable port operations and reduce the environmental impact of port activities. The findings of the study suggest that NMPA has made significant progress in promoting green ports through the adoption of various strategies and initiatives.

One of the significant green port strategies adopted by NMPA is the development of a comprehensive Environmental Management Plan (EMP) that outlines the port's environmental policies, targets, and strategies. The EMP covers various environmental issues, such as air quality, water quality, waste management, and noise pollution. The EMP also includes a monitoring and reporting mechanism to track the port's environmental performance and identify areas for improvement.

Moreover, the study highlights that NMPA has implemented various initiatives to reduce the carbon footprint of port activities. For instance, the port has invested in energy-efficient lighting systems, solar power plants, and shore power supply systems to reduce energy consumption and greenhouse gas emissions. The port has also implemented measures to reduce the emissions from ships, such as mandating the use of low sulfur fuel and incentivizing the use of cleaner technologies.

The study also suggests that NMPA has developed a comprehensive waste management plan that focuses on reducing waste generation, promoting recycling, and ensuring proper disposal of hazardous waste. The plan includes the development of recycling facilities and the promotion of waste reduction and segregation practices among port users.

Furthermore, NMPA has implemented measures to promote biodiversity conservation and ecosystem restoration. The port authority has undertaken mangrove plantation and coral reef restoration initiatives to promote marine biodiversity and ecosystem health.

The findings of the study also suggest that NMPA has undertaken various stakeholder engagement and capacity-building initiatives to promote green ports. The port authority has organized awareness campaigns and training programs for port users, employees, and local communities to promote environmental sustainability and build support for green port initiatives.

In conclusion, the study on green port strategies of New Mangalore Port Authority highlights the efforts and initiatives taken by the port authority to promote sustainable port operations and reduce the environmental impact of port activities. NMPA has adopted various strategies, such as the development of an Environmental Management Plan, implementation of measures to reduce carbon footprint, and waste management and biodiversity conservation initiatives. The port authority has also engaged stakeholders and built capacity to promote environmental sustainability and build support for green port initiatives.

However, the study also highlights some areas where NMPA can further improve its green port strategies. For instance, the port authority can consider the implementation of more stringent regulations to reduce emissions from ships and promote the use of cleaner technologies. The port authority can also explore the use of alternative fuels, such as hydrogen and ammonia, to further reduce the carbon footprint of port activities. Additionally, the port authority can consider the development of a circular economy model to promote the reuse and recycling of waste generated by port activities.

Overall, the study on green port strategies of New Mangalore Port Authority highlights the importance of adopting green port strategies to promote sustainable port operations and reduce the environmental impact of port activities. NMPA's initiatives can serve as a model for other port authorities in India and worldwide to adopt similar strategies and promote environmental sustainability in the maritime industry. It is recommended that NMPA continues to prioritize the adoption of green port strategies and collaborate with stakeholders to promote sustainable port operations and contribute to global climate goals.

5.2 Recommendations

Based on the findings of the study on green port strategies of New Mangalore Port Authority (NMPA), the following recommendations are suggested to further enhance the port's sustainability and environmental performance:

1. Promote the use of alternative fuels: While NMPA has made significant progress in reducing the carbon footprint of port activities, the port authority can further explore the use of alternative fuels, such as hydrogen and ammonia, to further reduce emissions from ships and port equipment.
2. Develop a circular economy model: NMPA can consider developing a circular economy model to promote the reuse and recycling of waste generated by port activities. This would help reduce waste generation and promote resource efficiency.

3. Strengthen regulations on emissions: NMPA can consider implementing more stringent regulations on emissions from ships and port equipment to promote the use of cleaner technologies. The port authority can also incentivize the use of low-emission technologies and support the development of innovative solutions to reduce emissions.

4. Engage in partnerships and collaborations: NMPA can engage in partnerships and collaborations with other stakeholders, such as NGOs, research institutions, and private sector companies, to promote sustainable port operations and share best practices. This would help build a more sustainable and resilient maritime industry.

5. Promote biodiversity conservation: While NMPA has undertaken mangrove plantation and coral reef restoration initiatives, the port authority can further promote biodiversity conservation by supporting research and development of innovative solutions to mitigate the impact of port activities on marine ecosystems.

6. Develop a sustainability reporting framework: NMPA can develop a sustainability reporting framework to track and report its environmental performance and communicate its sustainability initiatives to stakeholders. This would help build transparency and accountability in the port's sustainability efforts.

7. Enhance stakeholder engagement: NMPA can enhance stakeholder engagement by involving local communities, NGOs, and port users in the port's sustainability initiatives. This would help build support and ownership for sustainable port operations.

The study on green port strategies of New Mangalore Port Authority highlights the importance of adopting green port strategies to promote sustainable port operations and reduce the environmental impact of port activities. While NMPA has made significant progress in promoting green ports, there is still room for improvement. The above recommendations can serve as a guide for NMPA to further enhance its sustainability and environmental performance and contribute to global climate goals.

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