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FUTURE SUSTAINABLE MARITIME SECTOR: FISHING CARRIERS AND THEIR ADOPTION TO THE ENVIRONMENTAL REGULATIONS. PART I

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ABSTRACT

The study explored the legislative database for the maritime sector to be sustainable and have an intact blue economy. The problem for organizations with shipowners that have fishing boats older than 20 years is stated. Decision-making authorities face challenges nowadays. To be in the fleet for the next decade, shipowners for their ships should deploy energy efficiency projects for marine system retrofitting to improve energy efficiency and meet environmental regulations. The Ship Energy Efficiency Management Plan's development principles are discussed due to the current need for its deployment from 2021, so shipowners can contribute to the fast adoption of new regulations by the International Maritime Organization. In this work it is being offered to incorporate energy management issues with guidelines for upcoming regulations as well as those that are currently enforced. To improve energy efficiency, reduce environmental impact and cut fuel consumption costs, marine system retrofitting has been proposed. In this paper the focus is being put on studying energy management strengths and weaknesses which can lead to a qualitative understanding of the performance of the organizational structure, this work also focuses on the management settings concerning energy efficiency. If the organization wants to win by integrating energy policy, high-quality communication or promotion of energy efficiency issues should be employed. Marine plastic debris challenges fishing carriers on the African Union route. A possible beneficial solution for shipowners is discussed in this study.

Keywords: Maritime Sustainable Scenario Policy, Energy Management, Energy Efficiency, Fishing Carrier, Marine Plastic Debris

INTRODUCTION

According to the final communication from the commission to the European Parliament in May 2021 [1], a new approach to a sustainable blue economy has been discussed. The European Union (EU) implemented a directive on Maritime Spatial Planning in 2022, proposing cross-border cooperation as a key element of the EU policy and cooperation facilitated by the Commission. The key idea is to push the Member States forward in the direction of objectives integration of offshore renewable energy development in their national spatial plans. Promoting renewable energy systems is the way to succeed.

In order to improve the existing situation balked with natural disasters and climate change, the EU Commission decided to continue the involvement of various types of investments as tools that can improve the desired relationship with important actors on the international arena. This is being done in order to achieve the EU sustainable development goals by implementing them into the blue economy. The Commission was forced to develop supply chains [2,3] for

empowering linkage between the blue economy and the Trade Policy, playing to the realization of the future Maritime Sustainable Scenario.

The maritime security strategy [4] and the associated action plan set out a cooperative response to modern dynamic world challenges concerning environmental security, environmental risks reduction, accidents, waste dumping, and illegal discharges and their prevention.

As 70% of the EU's external borders are maritime, the major part by the EU's trade in goods is carried by sea. Estimates show that the EU is the 3rd largest importer and the 5th largest producer in the fishing industry and aquaculture worldwide.

For ecosystem stability, blue economy value chains become global laying into the base of the world business that promotes required expertise, environmental action plans, and new rule of law according to Sustainable Fisheries Partnership. During the last decade, Asian countries and the African Union [5] have actively participated as maritime policy developers to secure the environment. The EU Commission will consider setting up an EU-Africa blue task force, which would support investments in a sustainable blue economy.

There are fishing carriers in use with the manufacturing year 2000.

How they can be adapted to the sustainable maritime blue economy?

Here come key challenges:

- to clear vision for adoption of maritime policy as a part of the sustainable scenario
- to improve energy efficiency;

MARINE PLASTIC DEBRIS

From the last decades, marine plastic debris has been a key issue worldwide causing countries and organisations to develop new action plans on how to solve the growing problem. Most marine debris is linked to human interaction with the maritime sector and originates on dry land [6]. According to Lebreton et al. [7], the 20 most polluted rivers in the world are responsible for two-thirds of all maritime sector debris. Corresponding to Ronkay et al. [8], about 18% of marine plastic debris officially originates in the fishing industry from altogether: fishing-related wastes like buoys, lines, nets, and other fishing gear, also from plastic wastes from human-related items like buckets, bottles, foamed polystyrene, bags/films, and miscellaneous plastics.

Dauvergne et al. [9] have made assumptions that plastic flowing into the oceans will double from 2010 to 2025, and that problem impacts both ocean pollution and the onboard systems' performance of many ships. As a result, governing plastic waste is a huge problem during its dispersal, durability as well as mobility.

International trade institutions do not make any contributions to problem-solving during the gap in their weaknesses. There are no well-adopted regulations according to control and monitor the regulation's executions by region. Also missing a business-oriented solution leads to growing marine plastic pollution. Irresponsible consumers with resist government regulations as another reason for problems occurring. The executive branch is forced to perform sharp control by monitoring a situation and reporting to the government about its actions on a regular base. Legislative authority should encourage the industry to scale up local reforms in order to meet environmental regulatory requirements.

THE EUROPEAN GREEN DEAL

The European Green Deal (EGD) [10] is mobilizing the industry for a clean and circular economy, zero pollution, restoring ecosystem, sustainable and smart mobility. Policies intended for minimising harm to nature, biodiversity, and human wellbeing. The green transition plan rises up carbon emissions-cutting, cleaner energy sources adopting, as green technologies application to prevent environmental-related risks.

European Commission (EC) wants to reach targets by 2030: to reduce greenhouse gas emissions by 55% (from 1990 levels), to improve energy efficiency by 32.5%, and to increase renewable energy by 32%. In order to reach these targets on time, the EC created a dedicated action plan known as the EU Green Deal.

The EU enacted new regulations in order to meet the target of "zero" pollution (Net-Zero Law) [11]. International shipping [12] accounted for approximately 2% of global energy-related CO_2 emissions in 2019.

The International Maritime Organization (IMO) [13] has standardised regulations and put them in place for emissions control (air pollutants from ships) with its mandatory data collection systems as well as its mandatory energy-efficiency measures to reduce Greenhouse Gas (GHG) emissions. Ships passing through NO_x-Emission Control Areas (NO_x-ECAs) must adhere to mandatory engine standards or employ equivalent NOx-Emission reduction technologies, as of January 1, 2021.

Energy efficiency-improving methods used together with environmental impact reduction methods are most desired for any energy efficiency project if it is required to meet a sustainable development scenario. Energy utilization (hot or cold) is a possibility to reduce both fuel consumption and carbon emissions along with improving energy efficiency. A research group from China [14] represented the cold energy utilization system as part of an energy-efficiency improvement program for LNG-powered container ships that lead to reducing carbon emissions. It can be a good option for shipowners to meet the International Maritime Organization requirements.

The energy efficiency analysis process (for ships), which is based on the energy quantity only, may lead to deceptive results. If we talk about a waste energy recovery that is intended for heating purposes, a ship can recover mostly all energy. It seems efficient from the energy viewpoint. At the same time, fully recovered waste heat from all available

(that can be produced by energy systems) on the ship doesn't indicate the existence of an efficient way of performing a recovering process. Using energy analysis, it is possible to determine the energy potential and boundary conditions for detecting the ineffectuality of the thermomechanical systems.

Bocheński and Kreft [15] proposed methods, using "probabilistic models" as tools for analysing various marine heating systems' solutions to determine the operational consequences associated with these solutions. Solutions and to develop a method for forecasting the parameters of the operational distribution of heat demand on cargo ships. In practice, it is common that errors leading to failing projects have mostly occurred during the design process. So, developing a new method that can contribute to improvements in the design process is desirable for the maritime sector. It can finally contribute to EGD.

During the pre-parametric design process of new ships, Turkish scientists, Okumuş at al. [16] proposed mathematical relationships (gradient boosting machine (GBM) regression algorithm) that can be used to estimate the power of the engines, emissions with prediction opportunities of the main engine and auxiliary engine power used to build "green" ships.

A Ukrainian research team, Kuznecov at al. [17] proposed the use of ejection cooling devices as part of the exhaust system to reduce NOx emissions in exhaust gases and to cut costs for the Selective Catalytic Reactor (SCR) maintenance in the exhaust system for the tanker with a deadweight of 45,564 t. Presented recommendations let shipowners both perform their work within environmental regulations and improve system efficiency.

System flexibility would allow the system to handle a variety of issues, in order to improve system performance that could lead to cost-effective shipping, cutting fuel consumption, and reducing environmental impact.

Abramowicz-Gerigk and Burciu [18] proposed new steering devices, including a dynamic coupling system and bow rotors on the pushed barges, to improve maneuverability and reduce the required maneuvering area for the push train that allows for operating the ship more efficiently.

REFRIGERATION TRANSPORT. REFRIGERANTS

Improving energy efficiency is a crucial issue for cold chain participants, refrigeration transport in particular.

The majority of refrigeration systems used on fishing vessels (fishing carriers) due to high vibration, together with hard operating conditions (storm) during refrigeration system performance, refrigerant leakage occurs and quite high that request to retrofit refrigeration systems to natural refrigerants in order to reduce Ozone Depletion Potential (ODP) and Global Warming Potential (GWP).

From the Cold Facts 2018, "25% of the Northern Prawn Fleet is still operating on Hydrochlorofluorocarbons (HCFC-22)". The start of the HFC refrigerants (hydrofluorocarbons) reduction phase under the Kigali Amendment to the Montreal Protocol has affected fishing carriers. The fishing carrier refrigeration system configuration allows for a future transition to a natural refrigerant-charged system.

Montreal Protocol regulates Ozone Depleting Substances (ODS) which is included *Chlorofluorocarbons* (CFCs), and *hydrochlorofluorocarbons* (*HCFCs)* refrigerants. EU F-gas legislation regulates HFC refrigerants with high GWP value in order to replace halogenated hydrocarbons on the halogen-free is in charge for single working fluids: R717, R290, R600a, R170, R744, R718, R1270; and for mixtures: R600a/R290, R290/R170, R723 (NH3 (60%) and dimethyl ether "DME" (40%)) at [19].

EU Commission presented regulations on substances that deplete the ozone layer for the maritime sector, pushing the maritime sector to deploy them. At the same time MARPOL - the International Convention for the Prevention of Pollution from Ships or Marine Pollution convention aims [20] to prevent pollution to the marine environment by ships from the following: ODS release to the air, installations on ships, ODS-containing equipment. Log Ozone Depleting Substances list is needed to be used to ensure suitable reception facilities for equipment when removed from ships. It is controlled by the International Maritime Organization. Parties to the Montreal Protocol recently decided that Technology and Economic Assessment Panel (TEAP) should engage with the International Civil Aviation Organisation (ICAO) and the IMO in order to identify the relevant alternatives currently available or in development to retrofit refrigeration systems that have a harmful environmental impact.

Energy efficiency together with energy security regulations contributes significantly to the problems in the environment within the maritime sector for ship manufacturers and owners.

ENERGY MANAGEMENT WITHIN ENERGY AUDIT

Each expert understands that not only system performance is a keystone but system management brings a lot of opportunities to improve energy efficiency as well. A qualitative sheet of investigation can allow judging the performance of organisational structure and management settings with regards to energy efficiency. At the same time, it can give us an idea of what further steps are possible to improve system performance.

Energy auditors execute commitments together with energy policy implementation and start to answer questions. Is there policy explicitness or not? Are there guidelines or not? Is there a policy that is not adopted? Is there adopted policy formally without a commitment from the management side? A recommended energy policy with an active commitment from the managerial.

Roles and staff responsibilities are under investigation as well. Energy auditors should go through delegation of responsibilities, answering a set of questions. Whether is it an informal "ad hoc" delegation of responsibilities or

not? Some delegations of responsibilities can have a place but can be unclear and can be with unstrict management involvement lines. It is recommended energy management is fully integrated into the organization with clear and strict line management accountability.

If targets and energy efficiency projects are in use, in this case, the expert focuses attention on the energy targets and invests in energy efficiency improvements. Only targets with low-cost initiatives are desirable to shipowners. System measurements with low and medium costs and a short payback period attract interest as well. The same energy management cost criteria are in use for the following cost reduction energy efficiency. Recommended way for targets and energy efficiency projects to perform life cycle cost analysis for energy efficiency investment evaluation together with carbon footprint reducing approach according to IMO requirement.

Energy performance should be monitored and analysed for significant energy use. Experts take into consideration: where is an accounting of energy consumption, whether is limited "ad hoc" tracing of energy consumption, whether is monthly monitoring with a set of limited sub-meters and cost reporting, whether is monthly monitoring and accounting based on the sub-meters with remote monitoring, whether it is associated with the company's system? A recommended way for the owner is to make comprehensive energy performance monitoring which is entirely integrated with daily routine operations.

Without awareness and training, the quality of energy management is reduced. The expert goes through whether it is necessary for energy-related staff training to be provided. Energy auditors continue to answer on question list, whether it is engineers (technical staff) who rarely attend special courses or not, whether it is ad-hoc internal training for certain staff or not, and whether it is energy training for major system users or not. A recommendation to solve this problem is to perform appropriate and comprehensive staff training that is tailored to defined needs and requirements.

The communication part of energy management is an important issue.

The objectives of the study:

- To make a clear understanding of the development of a Ship Energy Efficiency Management Plan (SEEMP) and the need for its deployment with the Energy Efficiency Operational Indicator (EEOI), Energy Efficiency Existing Ship Index (EEXI), and the Carbon Intensity Indicator (CII)
- To reduce the environmental impact of the onboard systems
- To propose a solution for maritime plastic debris

SHIP ENERGY EFFICIENCY MANAGEMENT PLAN. MONITORING SHIP AND FLEET EFFICIENCY PERFORMANCE.

Deploying a Ship Energy Efficiency Management Plan (SEEMP) is one of the key objectives for companies and shipowners. From the IMO energy efficiency measures [21], it is an "operational measure that establishes a mechanism to improve the energy efficiency of a ship cost-effectively". The SEEMP offers an opportunity for shipping companies to manage ships efficiently and to manage fleet performance efficiently for the time required. Furthermore, the Energy Efficiency Operational Indicator (EEOI) might be used as a monitoring tool.

A SEEMP can be effectively used for environmental performance management, operational efficiency improvements, reducing emissions, and, moreover, cutting costs. According to SEEMP, the IMO pushes shipowners to contemplate new technologies and practices at each phase of the plan. Within MARPOL [22] additional regulatory tools, IMO has taken the lead on the following issues: improving energy efficiency and reducing GHG emissions. In 2021, the SEEMP regulations were adopted for all cargo, including the RoPax and cruise vessels, each weighing more than 5,000 GT. The key part of SEEMP (which will be enforced in 2023) is the issue of how to reach the required carbon intensity indicator

To develop SEEMP, the classical approach for energy management systems, according to standard ISO50001 listed in Table 1, can be used.

Tab. 1. Plan-Do-Check-Act specified for the maritime sector

Plan	To set ship and company-specific measures, HR development, and goal setting with key issues to reduce on-board administration. Include interconnection with company goals and processes, ship features within technical and operational areas, pieces of training, competence, and timetables
Do	To establish and deploy the required system that allows for each chosen measure to be rolled out affording to the SEEMP. The priority for a customer is that any existing system can use a mix of tools and processes, recording them to get opportunities for energy efficiency initiatives realization. Additional plans for responsibility role setting enhance the probability of sustainable activity being performed. A SEEMP can be a part of the Safety Management System which is mandated by the International Safety Management (ISM) Code [23]. It can be an additional initiative or broader energy management activity.
Check	In order to define monitoring system establishment using different tools, any form gained access may provide both qualitative and quantitative foundation for self-evaluation and successive performance reviews. The rule is using the right tool for the right place at the right time. Tools, systems, system elements, and processes are vital for achievement measurement and to ensure that improvement is sustained. A systematic approach for information management is in use in order to check system performance.
Act	This step allows for the completion of the cycle or for improvement by analysing the effectiveness of energy efficiency activities that were deployed. It can define options for improvements to processes as well as previous results that were/are reported to stakeholders. It will create awareness and trust within the energy efficiency improvement program as well as its activities. Include feedback on a regular basis to stakeholders using communication tools and plans validation.

While all cargo should use the SEEMP as the operational measure, shipowners must have a clear understanding of the proposed changes to better assist the IMO in its recommendation's realization.

The SEEMP deployment at a particular ship level is a part of the energy management policy. Assuming that a shipping company operates multiple ships, the corporation integrates a comprehensive energy management policy for all of the ships in its fleet. It can be a proper foundation for the SEEMP development as the operational measure for a specific type of ship.

The priority target of the SEEMP is to improve the ship's operating efficiency as a system for a long-term perspective, using required as well as optimized methods and techniques intended for energy efficiency improvements and fuel savings.

Both cutting costs for fuel and preventing environmental ship pollution releasing (strongly restricted by environmental regulations) are crucial issues for shipowners. The SEEMP helps with adopted methods to reduce fuel consumption and cut fuel costs. Proposing alternative fuels for use, that can cause less greenhouse gas emissions, the SEEMP does work according to requirements.

ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI)

The energy efficiency operational indicator (EEOI) helps for measuring the fuel efficiency of the ship in operation. To assess the outcome of any changes in operation, it can be of great use for tracking improved voyage planning or changes in the maintenance of a ship's technical systems.

The data from the ship operation which can be attained from the ship's logbook, bridge log-book, engine log-boo, and deck log-book include official records using C_F is a non-dimensional conversion factor between fuel consumption and CO2 emission. It is based on the carbon content proposed in [24]. Empirical analysis of ships from the Royal Belgian Shipowners' Association represents in detail analysis [25].

The EEOI for a voyage is defined as Eq. 1:

$$EEOI = \frac{\sum_j FC_j \times C_{Fj}}{m_{cargo} \times D} \quad \textbf{(Eq.1)}$$

Where the average of the indicator for a period or a number of voyages is obtained, the indicator is calculated as Eq. 2:

$$AverageEEOI = \frac{\sum_i \sum_j \left(FC_{ij} \times C_{Fj} \right)}{m_{cargo,i} \times D_i} \quad \textbf{(Eq.2)}$$

j – the fuel type;
i – the voyage number;
FC_{ij} – the mass of fuel consumed j on voyage i;
C_{Fj} – the fuel mass to CO_2 mass conversion factor for fuel j;
m_{cargo} – cargo carried (tons) or work done (number of TEU or passengers) or gross tonnes for passenger ship;
D – the distance in nautical miles corresponding to the cargo of work done.

According to sustainable future maritime sector plans [26], "signatories to the Poseidon Principles for Marine Insurance have set the bar high on their ambition, not only in terms of measuring the climate alignment of their portfolio relative to a 100% CO_2 reduction goal by 2050 and aiming to align with the Paris Agreement in time but also the scope of the global fleet that this new initiative would include". Shipping companies should be open to not only energy efficiency management together with energy management policy implementations but also to innovations which new technologies bring with them.

From investigating recent changes within regulations, it is derived and must be known that shipowners will adopt the Energy Efficiency Existing Ship Index (EEXI) and the Carbon Intensity Indicator (CII) for use in the near future. During the Marine Environment Protection Committee session [27] (MEPC 76) in 2021, the IMO realized amendments to MARPOL Annex VI, which represents the EEXI is applied to almost all oceangoing cargo and passenger ships weighing more than 400 gross tonnage. The regulations will into force by 2023.

EEXI together with CII incorporates a valuation of potential operational changes considering optimal energy efficiency technologies for energy efficiency improvements that are best suited for the ship under investigation.

MARINE PLASTIC DEBRIS

When the vessel is fully loaded, the level of seawater intake (for the refrigeration system) is below the level of the floating plastic debris in the ocean, which keeps the plastic from entering the system for a while. Due to the floating-level changing from a fully loaded to a completely unloaded fish carrier, plastic ends up in the sea chests during the water intake process and then it goes into the filters. While the fish carrier unloads, the time until the next maintenance for pre-filters, water pumps, water-cooled shell and tube condensers decreases.

During fish carrier routes in EU waters, the refrigeration system maintenance is scheduled for 1 time per month. The African Union route in comparison with EU route brings with cardinal changes to the maintenance time of onboard systems and refrigeration systems in particular. Technical parts work continuously. During water pump maintenance in Fig 1.it is possible to see marine plastic which is caused problems.

Fig. 1. System maintenance

Some types of plastic, including plastic bags (85% of marine plastic debris) and plastic bottle caps, pass through the filter. Plastic bags passing through the filter go to the system, which leads to the water pump run-out. The tube plate of the condenser is clogged, which leads to the water supply decreasing by 2 times. Due to the deviation of the water pump from the set parameters mode (plastic in the system) plus a clogged condenser tube sheet, the seawater supply at the condenser inlet is reduced to 20% of the main flow.

As a result, marine debris is not only harmful to the ocean ecosystem but also causes troubles with onboard systems. Shipowners try to solve their problems technically but any technical solution to manage plastic debris for an organization brings additional costs including systems maintenance costs.

RESULTS

The owner of the fishing carrier is trying to adapt their ship, which has installed a refrigeration system with HCFC-R22 refrigerant and is still operating within the existing regulations. After eight-ten years, the owner is planning to put out of use this ship. In order to meet new coming regulations that put strict requirements concerning energy systems' environmental impact. For an energy efficiency improvement program, it is being proposed to use refrigerants R290, R744, and R717 for the refrigeration system to reduce environmental impact, and global warming potential and to reach desired energy efficiency for system performance.

Not only energy audit is required to be done for energy efficiency program development but its deployment, considering energy management strengths and weaknesses.

After energy auditing, auditors derive energy potential to make a clear understanding of what energy can be saved potentially or what system, system element, or process can be improved in order to improve system energy efficiency. Auditors go to the next step – energy efficiency improvements, energy savings program development, and transferring to the customer. After program realization, organization energy managers start to work continuously with energy efficiency issues expressed in the Action Plan, the plan of activities intended for energy efficiency improvements and energy savings. Energy managers during energy auditing should accurately go through energy management strengths and weaknesses to make the analysis of how well energy efficiency issues can be managed within the organizational structure and management settings.

Adopting energy policy and having an active commitment from the managerial side, to fully integrate energy management requirements and rules, and being open to new energy efficiency projects can help to win extra for the organization. To carry staff training in order to define needs and requirements, and finally, to grand the efficient energy management with good communication concerning energy issues within organizational system inside and outside of it – these activities will lead the organization to become a leader in the market.

Regulations put to use SEEMP for each ship with a more than 400 GT from 2021. With a clear understanding of SEEMP development principles and its purpose shipowner can be ready for SEEMP adoption.

They will be used in the near future, and shipowners should have a sharp understanding that their ship can be put out of the fleet even before the desired term (following 8-10 years in the fleet) if the proposed program for improving energy efficiency is not implemented.

If an organization tries to meet the requirements of sustainable scenario development, blue economy, green ships programs deployment, within regulations, such move from shipowner side can create new opportunities for energy systems (refrigeration system as a part of) retrofits or modifications to look for new saving opportunities in improving energy efficiency. Arguing concerning environmental restrictions leads to nowhere.

Marine plastic debris is considered a problem, and through interviews with shipowners, it was derived that regional authorities must undertake harder control of the regulations which are currently enforced in the African Union. It is a pity, not much happens here. Marine plastic debris utilization hinders the marine refrigeration system

performance and maintenance time. It should be resolved by specified institutions not only for environmental regulation adoption control but sharp monitoring from the regional authority for illegal waste dumping to prevent it.

DISCUSSIONS

Marine transport is a key player in the food supply cold chain. From the second the temperature-sensitive fish is caught, the cold chain has to be maintained in each phase (from fishery to processing, from processing to a supermarket, and from supermarket to customer home) until the fish is lastly prepared for food.

In order to reduce fuel consumption, ship-owner can improve refrigeration system energy efficiency. To deploy sustainable development achievements and best practices within protecting the quality of the environment that can lead to stable ecosystems and support worldwide society for human well-being.

Shipowners of fish carriers should be interested in being informed about upcoming environmental regulations controlled by the International Maritime Organization and in making it easier for their quick adoption.

It is a crucial issue to have good energy management not only to deploy energy efficiency projects by retrofitting or optimizing systems in order to improve system performance, cut costs for fuel consumption and reduce the environmental impact. That is why improving communication within the organization (fast feedback from the project manager to occurring complications from the engineering stuff concerning energy efficiency issues) can create stronger management.

Old ships (more than 20 years in the fleet) need energy auditing for the possibility to be in use for the following ten years. Shipowner organization is a polish organization and conducts its own business from small orders around the EU to mostly African Union activity.

Using recommended refrigerants by the environmental regulations and the IMO for refrigeration systems leads to reducing their environmental impact.

Using a reward system for manufacturing (for reducing pollution) is a good encouragement to control environmental regulations execution for the Africa Union route.

CONCLUSIONS

A clear understanding of IMO regulations and requirements to adopt the Ship Energy Efficiency Management Plan can help organisations to work on a higher level with energy efficiency issues for their continuous improvements in order to cut costs.

Refrigeration system retrofitting is proposed for natural refrigerants (R290, R744, R717), which are approved by Montreal and Kiyoto protocols, the Kigali amendment, and other environmental regulations. By improving energy efficiency with clever energy management and retrofitting marine refrigeration system shipowner gets new possibilities to get profitability.

Marine plastic debris utilisation and prevention of waste dumping should be controlled by regional authorities concerning the legislative base.

Fishing carriers are a part of the cold chain that cannot be removed easily due to their impact on food security. By integrating energy efficiency projects within the ship-owner organisation, it is possible to put in use old fishing carriers for eight-ten years more. During the following years, both the ship-owner organisation and African Union win from the proposed solution.

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