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The Identification of All Types of Facilities for Maritime Navigation Affecting Ecosystem in Saudi Arabia

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Abstract

Navigational tools, equipment and devices have developed and the ship's navigation officer has to take help in unconventional ways to plan and navigate the sea voyage. The ship's officer has a myriad of marine navigation equipment which makes the maintenance of ships, cargo and lives much easier, thanks to technological advances. Thus, preserving the marine environment. As the lack of training and inefficiency affect the environment, whether when maneuvering ships to dock in ports or during sailing, in addition to loading and unloading operations in ports. Moreover, current seafarers are trained to know how to work and operate all modern navigational equipment that made the journey at sea smoother, safer and more secure. Positive dimensions on the environment to be compatible with modern facilities and automation, the ship today has many advanced navigation equipment systems that provide accurate data for the voyage, thus avoiding many of the negatives that occurred in previous times.

Keywords: ARPA; Autopilot; Radar; Tracking; ECO system; Ship

Introduction

In the current project, a brief description of the ports located in the area under study on the western coast of Saudi Arabia, such as Jeddah Islamic Port-King Abdullah Port-Duba Port, will be addressed. The current and future plans for developing the port and its impact on the ecosystem, especially the current and expected movement of ships on those ports, will also be discussed. Including displaying port statistics from productivity, number of ships and their types, and the background of port activities related to the movement of the type of goods and ships coming to the region, as well as how to comply with other national and regional sources related to this type of information. To develop a marine risk assessment. The information is then collected from all the variables required to obtain a risk matrix assessment through field visits to the above-mentioned ports, to establish a marine buoy system, describe the type of navigational aids present in each port, and to identify and analyze potential risks related to the current conditions in which this type of assistance exists mobility and access channels. It will also address the basic requirements for towing and expansion in each of the ports of the western region and those specified above. Moreover, that complemented by an analysis of the national and regional coastal management framework/legislation and regulations applicable in the red sea.

The risk is to determine the degree of probability of an accident resulting in pollution and the extent of damage that could occur to natural resources (marine protected areas, coral reefs, coastal species, birds, fish, marine mammals, etc.) as well as negative social and economic resources (ships, docks, ports, fisheries, hotels, tourism, farms, leisure and sports activities, etc.).

Materials and Methods

The methodology used in the research depends on collecting data through the research tool (resolution), which includes the mechanisms to be followed to reduce the risks of pollution resulting from ships frequenting the ports of the western region of the Kingdom of Saudi Arabia, the importance of navigational aids in this regard, and highlighting the most dangerous mechanisms with negative consequences for the ecosystem by decreasing the likelihood of its occurrence and/or estimating the magnitude of its consequences. Where the possibility will be reduced through preventive measures for the safety of navigation, operation of loading and unloading at the different stations of each of the ports specified in the proposal, identification of the expected sources of pollution through refueling operations on the sidewalks, and the identification of necessary measures to reduce negatives on the ecosystem.

Therefore, in order to achieve the project outputs represented in the extent of application of the Saudi ports in the western region mentioned above, various bridge equipment and its uses that are installed on the ship are presented to help the deck officer in sailing the ship. Safely in addition, ascertaining the extent to which the Saudi ports use these tools, equipment and technology for the ships that frequent those ports to achieve the project outputs.

Problem definition

Ships emit large amounts of carbon dioxide. Where it represents ships sailing to and from the ports of the Kingdom of Saudi Arabia, specifically the western ports, and it is an important source of carbon emissions and others. It is expected that the emissions from shipping will rise rapidly to increase the movement of freight due to the increase in commercial flights and the maritime transport of goods of various kinds in the wake of the Corona pandemic, as well as due to the increase in the capabilities of Saudi ports to receive more different types of ships and shipping lines.

Global greenhouse gas emissions of maritime transport

Marine shipping emits large amounts of carbon dioxide, a known greenhouse gas, some of which can remain in the atmosphere for very long periods (thousands of years) and cause a significant warming of the climate. In addition, charging emits small amounts of refrigerants, some of which are greenhouse gases. Furthermore, ships emit a number of other pollutants including sulfur dioxide, particulate matter and nitrogen oxides. These pollutants which are not covered by current climate policies are complicated by short term warming and cooling effects on the atmosphere. However, it has been proven that carbon dioxide emissions remain a major problem and obligate future generations to irreversible warming.

Thus, the focus of this work is on the long term problem of greenhouse gas emissions of carbon dioxide from the shipping sector. This project follows the second IMO greenhouse gas study, which estimated in 2018 that global carbon dioxide emissions from shipping were 1,006 million tons of carbon dioxide, equivalent to 3.3% of anthropogenic carbon dioxide emissions (globalism). The uncertainty of this estimate is 20%. Carbon dioxide emissions during commercial cruise ships account for a large proportion of global emissions. About 90% of everything we consume is transported by sea. Moreover, as global trade continues to grow, there is an increasing number of ships crossing our oceans, each using huge amounts of energy. The shipping industry is the main responsible for emission of carbon dioxide annually, which is at least 2.5% of the world's total carbon dioxide emissions [1].

KSA key points

Ship pollution affects the health of communities in coastal and inland regions around the world, yet pollution from ships remains one of the least regulated parts of our global transportation system.

Saudi Arabia developed its first Nationally Determined Contribution (NDC) under the Paris agreement that included carbon mitigation targets up to 2030. It included many approaches and policies to mitigate carbon dioxide emissions from the energy and water sectors, which collectively contribute to more than 40% of emissions greenhouse gases in the country. It also included current efforts to expand non fossil electricity production and reform the energy sector as part of Saudi vision 2030. It addressed the practical implications of this policy approach on carbon dioxide emissions, electricity production, fuel consumption, investments and cost effectiveness.

Rationalizing fuel input costs is critical to driving significant reductions in CO_2 emissions and providing a net economic benefit to the Saudi economy. Fully liberalizing fuel prices leads to the largest reductions in CO_2 emissions of the scenarios considered in this study (1.2 billion cumulative tons through 2030) while providing $911 billion in net economic benefits. In this policy scenario, the power system supplies electricity demand through natural gas fired combined cycle gas turbines (64%) and solar PV generation (20%). A clean energy standard designed to achieve similar reductions could yield a positive net economic benefit of $394 billion. While significant reductions in carbon dioxide emissions can be achieved (Figure 1).

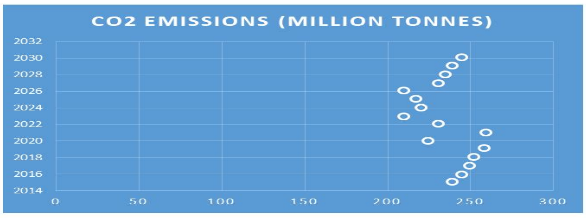

Figure 1: Emissions reduction pathways.

The 2015 Paris agreement fundamentally changed the nature of global cooperation to tackle climate change and its impacts. In line with the Paris approach, Saudi Arabia has developed the first Nationally Determined Contribution (NDC) referenced above to reflect the challenges and opportunities it faces as one of the world's major suppliers of crude oil in an increasingly carbon restricted world. The kingdom's nationally determined contribution aims to support and accelerate the reform of its economy while providing co-benefits for mitigating carbon emissions. The contribution aspires to avoid up to 130 million tons of carbon dioxide equivalent (CO_2e) emissions annually by 2030 through economic diversification and adaptation. It also included a set of supply side mitigation policy approaches relevant to Saudi Arabia and focused on the energy and water sectors, the two largest sources of carbon emissions, which together accounted for about 40% of Saudi Arabia's carbon emissions in 2014. While the current research project focuses on maritime transport sector.

Ship pollution calculations are based on the diesel engines of the world's largest ships of 85,790 kW that operate about 280 days per year and generate approximately 5,200 tons of sulfur oxides per year, while for example diesel and gasoline cars that travel 15,000 km per year and emit approximately 5,200 tons of SOx per year. Approximately 101 grams of Sulfur Dioxide SO_2/ SoX per year. While the world's largest container ships have 109,000 horsepower engines, weighing 2,300 tons. Each ship expects to operate 24 hours a day for 280 days a year and there are 90,000 ocean-going cargo ships then we make sure that Shipping is responsible for 18-30% of global Nitrogen Oxide (NOx) pollution and 9% of global Sulfur Oxide (SOx) pollution. While one large vessel can generate around 5,000 tons of Sulfur Oxide (SOx) pollution per year; and 70% of all ship emissions are within 400 km of land. Shipping is responsible for 3.5% to 4% of all climate change emissions.

The hard to decarbonize shipping sector was not part of the Paris agreement and is expected to account for an increasing part of global carbon dioxide emissions. Shipping plays a central role in global supply chains, which means that many industries will use the shipping sector to facilitate their net zero goals. Carbon free fuels and technologies are not currently available in the size, range, or price that the shipping industry needs for widespread adoption. The international freight and container shipping industry plays a central role in global supply chains, but until recently, it has made few strides toward decarburization. This must change if the world is to achieve net zero emissions by 2050. Shipping is one of the few sectors left out of the language of the Paris agreement on climate change. The industry currently accounts for a relatively small share of global carbon dioxide emissions between 2% and 3% according to analytics by S and P global plats but some scientists have predicted that sea freight could account for 17% of total annual CO_2 emissions by 2050. The fact ships carried by sea average more than 90% of world trade by volume. Unless the industry changes course quickly, many of the supplies other industries need to support their low carbon transition everything from wind turbine blades to lithium-ion batteries for electric cars will be transported aboard freight ships and containers fueled by fossil fuels, known to the industry as bunker fuels (maritime). In addition, as companies begin to pursue their net zero goals, we expect the freight of materials for the low carbon transition to rise. Some batteries, such as lithium ion batteries for electric vehicles, are already beginning to show an increase in demand [2] (Figure 2).

Figure 2: Compact 7,000–8,000 TEU ships–delivery projection

In April 2018, the International Maritime Organization (IMO) along with the United Nations specialized agency for international shipping adopted the IMO's preliminary strategy on reducing Greenhouse Gas (GHG) emissions from ships. The main objective of IMO's initial GHG strategy was to reduce total annual GHG emissions by at least 50% by 2050 compared to 2008, while pursuing efforts towards rapidly phasing out GHG emissions this century, in line with temperature targets to the Paris agreement [3]. Under "business as usual" scenarios, CO_2 emissions in shipping are expected to increase by between 90% and 130% by 2050 compared to 2008, depending on future energy developments and economic growth prospects [4,5].

Halim, et al. identify four different but interrelated areas of economic impact that could result from introducing maritime GHG mitigation measures such as carbon pricing: transport costs; transport choices; import prices; and international trade and economies of member states. The IMO initial strategy also lists transport costs as one of eight factors impact assessments should pay attention to costs (fuel substitution) and long run marginal costs (technology investment) to achieve deeper CO_2 emissions reductions. Increased revenue from oil exports and domestic sales of higher priced fuels to the power and water sectors could offset the mitigation costs by being redistributed to other sectors of the economy. This project does not explicitly model redistribution impacts but estimates that full fuel price deregulation would deliver the largest incremental economic gain by eliminating the opportunity cost of subsidized fuel consumption [6].

Results and Discussion

Directions in international shipping

There are developments affecting the processes of climate change negatively, but they are necessary and important for the economic and commercial life of peoples, as about 95% of world trade is handled and transported by ships, which is the main source of carbon emissions. Since maritime transport is the backbone of international commercial life, transport is a service that is not required in itself but is a service derived from the development of international trade relations and which results from the growth of world trade and the increase in sea freight, the globalization of economic activity is working to enhance international shipping, especially trade relations among industrialized countries and with emerging markets in Asia. The focus on export oriented growth is leading to the increasing expansion of international shipping by sea [7].

The order book for modern compact vessels of the 7,000–8,000 TEU class has reached 120 units, with 60 ships ordered in 2021 and 60 in the first five months of 2022 alone. At least 120 x 7,000+TEU ships or 'C7K' are expected to be delivered and join the global container fleet before the end of 2024.

The order book in this size class accounts for 0.84 MTEU and it is likely to hit 1.00 MTEU soon (Figure 3).

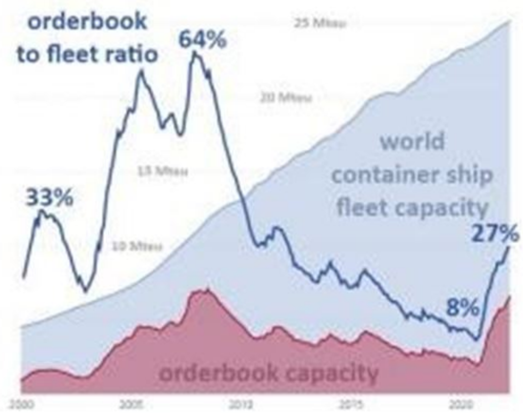

Figure 3: The order book for modern compact vessels of the 7,000–8,000 TEU.

LNG propulsion has gained traction in this size class with about 50% of all orders. For carriers and non-operating owners alike, this kind of tonnage is a low risk investment due to the ship type's flexible operating profile.

The Global containership order book is at an all-time high. From its 8.2% low point in Oct 2020; the order book to fleet ratio has climbed back up to 27.0% in May 2022. In capacity terms, today's order book is the largest in history at more than 6.80 MTEU and just under 900 vessels. However, containership orders are not without risk, especially now that new building prices at far eastern shipyards have increased significantly. Compared to the end of 2020, tightening yard slots, increasing steel costs and rising energy prices have pushed prices for container vessels up by 30% to 35%.

In addition, pollution and carbon emissions come from another source beside ships, where port operations also generate carbon emissions that lead to air pollution and increase noise. External factors such as air pollution emissions are among the most important negatives caused by port operations, and the use of equipment such as cranes and locomotives, not the quantity equipment, it is responsible to determine the emissions. It is also a problem in both sides of ships and ports as well as port expansions (e.g., port area expansion and stock of equipment) such as physical expansions of port infrastructure due to expanding port capacities and increasing infrastructure capacities [8].

Where the marine logistics chain includes the stage of maritime transport, loading and unloading in ports, in addition to internal transportation and shipments. Which, in turn, are main sources of carbon emissions and their impact on the marine ecosystem. Therefore, the optimum utilization of the port's resources is considered one of the effective remedies to reduce and strengthen the marine ecosystem.

Environmental dimension

Environmental data related to port activities are necessary and must be taken into consideration when we address the marine ecosystem, as the current literature on the negative costs of sea transport has mainly centered on pollutants from ships, while the current project specifically focuses on environmental problems due to port activities, whether from ships reluctant to the port or the internal activities of the port and the role of navigational aids in this direction.

Air pollution is usually estimated by combining activity data with emission factors, including cargo handling at ports. In addition, determining the extent to which Saudi ports comply with the general law on protection from pollution and waste (here in after referred to as the pollution law), which includes standards on carbon and noise emissions. The Saudi pollution law requires all ports to collect waste from ships as well as develop strategic plans for waste collection. Therefore, Saudi ports are obligated to report the amount of waste collected from ships to the Saudi maritime authority. The purpose of implementing waste management in ports is to prevent external costs, specifically emissions at sea due to waste dumping at sea. To achieve its sustainable development objectives, the Kingdom is engaging in actions and plans in pursuit of economic diversification with the following co benefits:

- Greenhouse gas emission avoidance, reduction and removal.
- Climate adaptation.
- Managing the impacts of response measures.

The Kingdom actively contributes to the UNFCCC and Paris agreement goals, while maximizing long term benefits and minimizing potential negative side effects. This NDC reflects the Kingdom's efforts in the context of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

KSA and Paris agreement

The Kingdom of Saudi Arabia reaffirms its commitment to Paris agreement goals and achieving mitigation benefits through economic diversification and adaptation. The Kingdom will implement actions, projects, and plans outlined in this submission that aim at reducing, avoiding, and removing GHG emissions by 278 million tons of CO_2 eq annually by 2030, with the year 2019 designated as the base year for this NDC. This ambition is more than a two fold increase versus the previous one as outlined in the Kingdom's INDC (130 million tons of CO_2eq). Thus, this submission represents progression and the highest possible ambition.

The ambitions set in this NDC are contingent on long term economic growth and diversification with a robust contribution from hydrocarbon export revenues to the national economy. Through its vision 2030, the Kingdom has already instigated a comprehensive set of unprecedented reforms in the public sector's operating model, the economy, and society as a whole. The new ambition is also premised on the assumption that the economic and social consequences of international climate change policies and measures will not pose a disproportionate or abnormal burden on the Kingdom's economy.

The Kingdom has embarked on a comprehensive and highly ambitious set of measures to realize its climate ambitions using the circular carbon economy framework.

The Kingdom is developing and implementing holistic and harmonized programs, policies, initiatives, and collaboration platforms to address climate change challenges at the national, regional and global scale. Examples include the Saudi green initiative, the middle east green initiative, the circular carbon economy national program, the national renewable energy program, and the Saudi energy efficiency program. The kingdom is also a member and active participant of major international initiatives such as global methane initiative, mission innovation, clean energy ministerial, and net zero producers forum.

The role of navigation aids in the port to protect the marine ecosystem

The term 'aid to navigation' is used internationally to refer to devices or systems external to vessels that are designed and operated to enhance the safe and efficient navigation of vessels on the water. Largely, they are buoys (floating marks) and beacons (fixed lights) and they are usually lit. The wide scope includes:

- Lighthouses.
- Lateral marks (red and green) identifying channels and routes.
- Cardinal marks (black and yellow) to show safe water related to the points of the compass.
- Isolated danger, safe water and special marks.
- Marks to designate water ski, marine farm and other reserved areas.
- Virtual marks using the Automatic Identification System (AIS).
- Warning signs and notifications (for speed restrictions, marking cables, marine reserves etc.).
- Radio, fog signals or other aids not carried on board any ship.

The International Association of marine aids to navigation and Lighthouse Authorities (IALA) provide guidance and recommendations on a global system of marks and lights. Its focus is safe coastal maritime navigation, although its guidance is also commonly adopted in inland waters and rivers.

Roles and responsibilities

The importance of aids navigation operating may be owned and maintained by private individuals, operators, councils or Maritime. The roles for different parties, including for oversight, are outlined below. Operators of maritime facilities: For example, operators of ports, jetties, marinas, oilrigs and marine farms:

- Must provide aids to navigation for any maritime facility they operate.
- Require approval from the director (or delegate) to erect, place or alter an aid to navigation.
- Are responsible for maintaining their aids to navigation (ensure they are in place and working).
- Keeping aids to navigation operating is important

- Persons who operate ports, cargo terminals, marinas, jetties, marine farms, or other maritime facilities (including local authorities) must provide navigational aids (aids to navigation) for those facilities and are responsible for them.
- For the purpose of ensuring maritime safety, regional councils are authorized to erect, place, and maintain navigational aids in accordance with maritime rules (if any), and to remove obstructions and impediments to navigation.
- In the case of pollution damage, a ship owner can argue that they are not liable if they can prove the incident was wholly caused by the negligence of a person responsible for the maintenance of lights or other aids to navigation.

  The port and harbour marine safety act: Responsibility for aids to navigation in the port and harbour should be clearly defined. Where the provision, ownership and maintenance of aids to navigation are split between different parties, this is formally agreed. Maritime Saudi is the authority responsible for giving effect to this international obligation. Its role is to:
- Ensure consistency with international guidance on aids to navigation.
- Adjust the recommended approaches for aids to navigation based on risk assessments. In addition ensures international obligations are met through having a formal approval process. Anyone who wants to erect, place, alter or remove an aid to navigation requires approval from the director. This is irrespective of who owns the aid to navigation. Even maritime Saudi officials must seek approval to erect, place, alter or remove aids to navigation operated by maritime Saudi authorities.

The IMO package for reducing CO_2 of shipping industry

The IMO marine environment protection committee has already developed a package of measures for reducing shipping's CO_2 emissions, with an agreed timetable for adoption. Inter alia, these include:

- A system of energy efficiency design indexing for new ships (similar in concept to the ratings applied to cars and electrical appliances).
- A template for a Ship Energy Efficiency Management Plan (SEEMP) for use by all ships. The SEEMP allows companies and ships to monitor and improve performance with regard to various factors that may contribute to CO_2 emissions. These include, inter alia: Improved voyage planning; speed management; weather routing; optimizing engine power, use of rudders and propellers; hull maintenance and use of different fuel types.
- The ingredients for possible economic measures that could be applied globally to shipping in order to encourage emission reduction; governments at IMO have also agreed key principles for the development of regulations on CO_2 emissions from ships so that they will:
- Effectively reduce CO_2 emissions.
- Be binding and include all lag states.
- Be cost effective.
- Not distort competition.
- Be based on sustainable development without restricting trade and growth.
- Be goal based and not prescribe particular methods.
- Stimulate technical research and development in the entire maritime sector.
- Take into account new technology.
- Be practical, transparent, free of fraud and easy to administer.

Relevant policies currently under consideration at the marine environment protection committee of IMO include:

- Policies aimed at reducing maritime emissions irrespective of the ship design, operation or energy source e.g. market based instruments such as emissions trading.
- Policies aimed at improving the operational fuel efficiency of the let (market based instruments such as the Energy Efficiency Operational Indicator (EEOI) levy, the Energy Efficiency Design Index (EEDI) levy/benefit scheme; command and control instruments such as the mandatory EEOI limit, mandatory EEOI reporting, and the mandatory Ship Efficiency Management Plan (SEMP); and voluntary measures such as voluntary agreements to improve EEOI and to implement SEMP).
- Policies aimed at improving the design efficiency of let (market based instruments such as the EEDI levy, the EEDI levy benefit scheme; command and control instruments such as the mandatory EEDI limit for new ships; and voluntary measures, such as voluntary agreement to improve EEDI and voluntary standards.
- Polices aimed at reducing fuel life cycle carbon emissions, such as policies that favour the use of natural gas or biofuels (market based instruments such as differentiated levy and command and control instruments such as fuel life-cycle carbon emissions standard and a biofuel standard).

Conclusion

As a result of this rapid technological development, more studies are needed on vessel interactions in vast and complex marine ecosystems. By improving our understanding of emerging needs in the modern marine industry, which are partly for ecosystem self-regulation, and partly linked to other systems, future accidents may be reduced. These include, but are not limited to, the marine environment, navigation and technologies, as well as the role of international organizations that frame, govern and regulate today's shipping industry. In the context of human error and accidents, many stakeholders the world's shipping stakeholders often have different and competing priorities between safety and economic interests.

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