وزارة المواصلات والاتصالات
Ministry of Transportation and Telecommunications

# Roadmap Towards Decarbonization

FOR THE SHIPPING SECTOR

JANAUARY 2023

# Sector Overview

**Global gross domestic product (GDP), trade and manufacturing sector activity are key drivers shaping energy demand in the international shipping sector.**

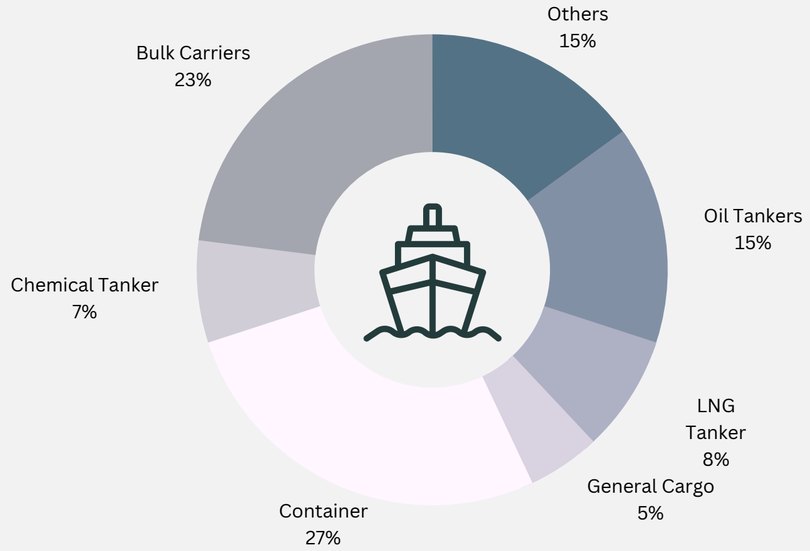
**90%** of international trade is enabled through maritime means,

**2.8%** of all green house gas emissions (GHG) are produced by the maritime sector

**85%** of the net shipping GHG emissions are associated with ( bulk and container carriers, as well as oil and chemical tankers).

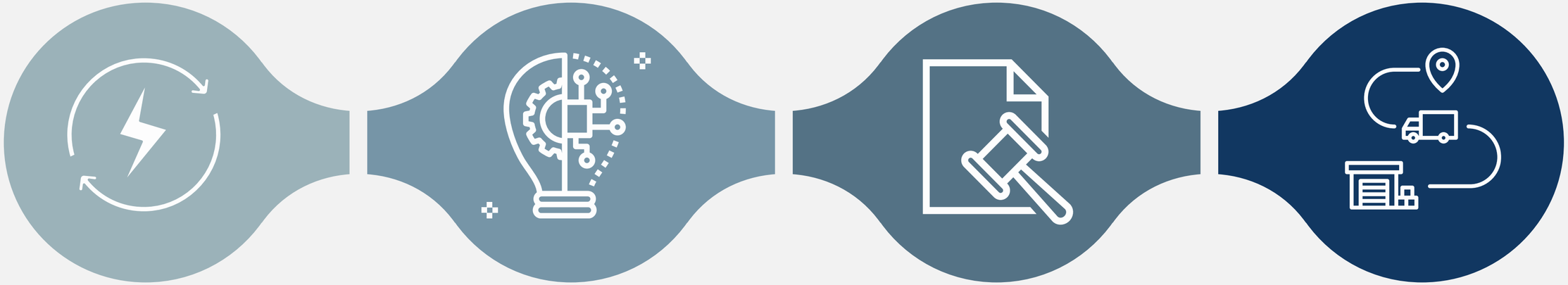
# International Community Concerns

The total number of vessels increased at an average annual **growth rate of 2.49%**, the need for more vessels, in which the global fleet of Large Ships (including tanker, containers, bulk) vessels grew at an average annual **growth rate of above 25%** notably increasing fuel consumption. The Fourth IMO GHG study (2020a) noted that six types of vessels were responsible for **85% of the energy consumption** associated with international shipping. The figure below demonstrates voyage-based allocation of energy consumption for international shipping




According to the fourth IMO GHG study using 2008 as a basis, maritime GHG emissions will likely i**ncrease by 90% to 130% by 2050** without the implementation of major decarbonization plans as the study reported that in 2018 global shipping resulted in approximately **1 Billion Tons of carbon dioxide CO2.**

# Key Pillars for Decarbonization



## Energy Optimization

Adopt global mandatory technical & operational energy efficiency measures. Looking into the introduction of alternative fuels and energy sources.

## Technological Developments

Initiate research to develop innovative technologies to further enhance the energy efficiency of ships and port operations.

## Policies and Regulations

Update national and international action plans to develop policies and strategies to address GHG emissions from shipping and ports.

## Value Chains

To further optimize the logistic chain and its planning, including ports by aligning the key value chains of the sector ( marine fuel, ship building, operation)

# Energy Optimization

The IMO Marine Environment Protection Committee (MEPC), produced the 2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP) to help in the selection of energy efficiency technologies. However the guidelines do not cover solutions for older fleet built before the IMO Energy Efficiency Design Index (EEDI) in 2013. Hence, navigating through the energy transition away from fossil-fuel-dependent combustion systems is still a significant challenge for the maritime transport industry, but the industry needs to be more energy conscious.

**Ways towards energy optimization:**

## ALTERNATIVE FUELS

According to IRENA report, the maritime fleet comprises of an approximate of 92,000 vessels.
The emphasis in mitigating emissions in the industry is by replacing current fuel sources with alternative greener fuels such as MGO, LNG, and LSFO, which have low Sulphur content in line with regulations dictated by IMO.

## RENEWABLE FUELS

The switch to renewable fuels is necessary to the sector, as alternative fuels are also considered of high CO2 emissions. Renewable fuels considered for the shipping industry include **biofuel, biogas, methanol, ammonia, and H2**. The use of such, requires further research as it imposes challenges due to cost and availability.

## OPERATIONAL EFFECIENCY

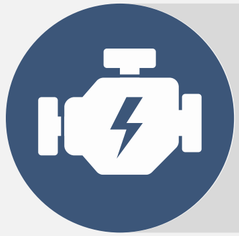
To reserve energy though optimizing shipping operations such as **Slow Steaming** which refers to the fuel-saving practice of operating a vessel at an average speed that is well below its design speed. Another strategy could be used is **full capacity utilization** by limiting empty container movements. Also, ports are to facilitate for **immobilization** in ports by allowing ME maintenance and repairs simultaneously with cargo operations. Also, **weather routing**.

## VESSEL ENGINEERING

To take incremental measures in the vessel engineering to i**mprove the hull design, propeller optimization and waste heat recovery** to increase efficiency. Another aspect to be looked into is **auto-pilot improvement**. **Vessel sizing** plays a major role in GHG emission . Improvements to a ship's **auxiliary systems** and the inclusion of **wind and solar energy sources** in vessel designs.

# Technological Developments

Throughout the history of international shipping, technological progress has been a leap driver in firms' and the sector's productivity, such as when shifting from wind sailing ships to steamships or when replacing manual and operating processes with automated and standardized systems. Today, emphasis on technological developments is the key to achieving decarbonization goals.



## Engine Technology

- Enhance fuel injection systems.
- Introduce Hybrid engines (diesel-electric).
- Waste heat recovery systems.
- Intake on valve closing engines.
- Spark ignition engines.
- compression engines using alternative fuels.

## Propulsion Technology

- Large Area propellers (LAP).
- Contra rotating propellers (CRP)
- Propeller Ducts.
- Pre-swirl propeller .
- Post-swirl fans.
- Podded thrusters.

## Digitization

- Automated operations
- Digitization of the shipping infrastructure.
- Digitalized cargo flows.
- Develop integrated systems.

# Policies and Regulations

## Establish realistic carbon levy

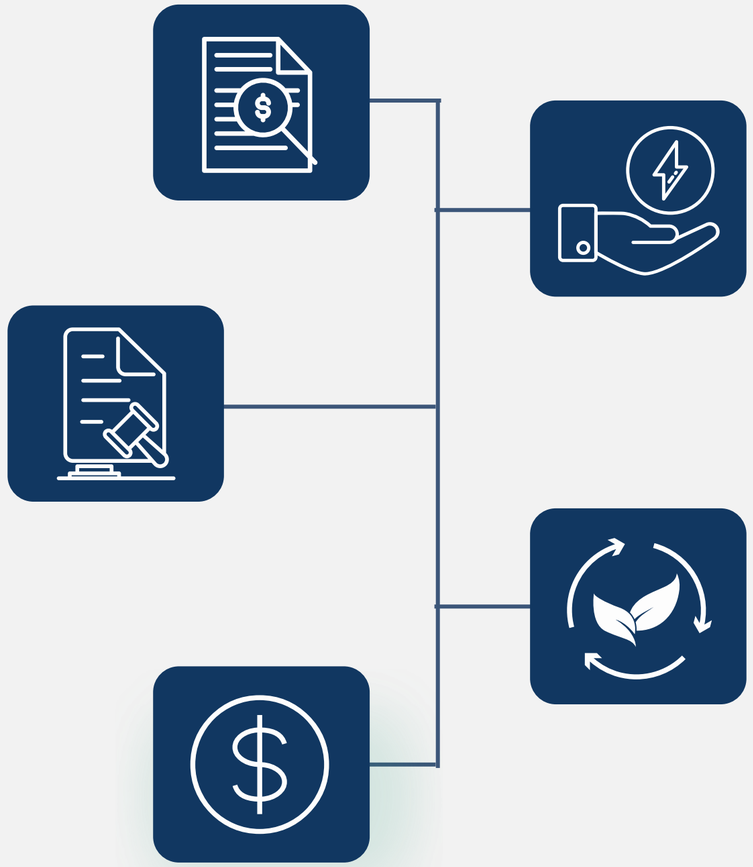
Taking early action will foster  foster the deployment of renewable fuels and prevent investment in fossil fuel infrastructure. An implementation to carbon levy requires stakeholder negotiations to enforce a mechanism.

## Promote local regulations to limit emissions

Establish regulations to limit airborne emissions at ports and inland waterways, and make cold-ironing (CI) at ports compulsory. Implement mechanisms and incentives focused on equipping ports with a reliable renewable power supply.

## Establish a mandate comprising the progressive increase of renewable fuels

Implement effective incentives to encourage vessel fleets to shift to green H2 -based fuels and the development of ammonia engines by  establishing effective incentives such as excise tax reductions for renewable fuels.



## Enforce energy efficiency measures

Mandates and policies should be comprehensive, of high technical level and provide minimum standards in terms of vessel design and operation and should address EE operational mandates must i) ensure periodical maintenance of vessels; and II) include energy management systems.

## Develop sustainability certifications to guarantee ship operators of the renewability index

Develop  regulatory systems focused on ensuring that increased power fuel production is aligned with renewable power capacity additions and/or suitable schemes harnessing renewable power.

# Value Chains

Development on the supply chain and logistics infrastructure will help mitigate GHG emissions in the shipping sector. The marine fuel value chain, the shipbuilding value chain and the maritime operations value chain are central to steering the sector's decarbonization actions and require aligning to efficiently move forward.

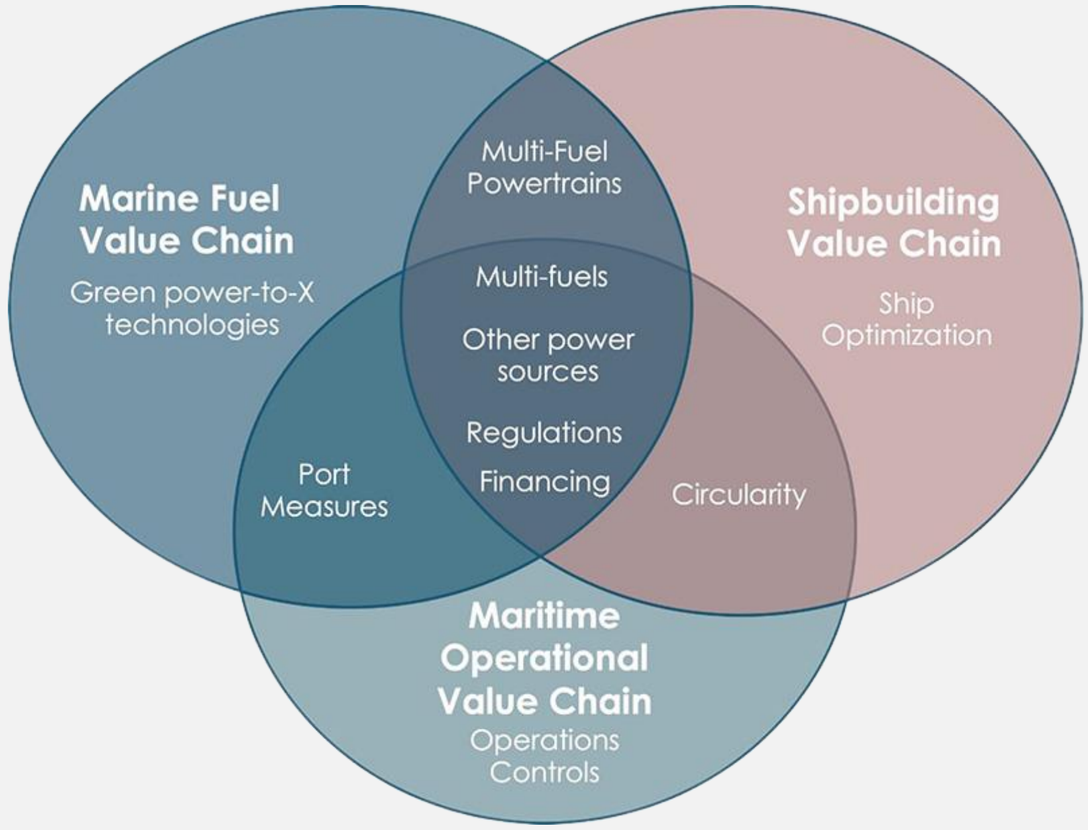
- **Marine Fuel Chain:** Maritime operators do not have sufficient price-competitive alternative fuels options to commit to charter agreements that include a premium for next generation dual-fuel engines. Alternative and renewable fuels are being developed with different timelines of availability on the market.

- **Ship Building Chain:** Shipbuilding value steps are ship design, procurement of construction materials, ship assembly, post-production maintenance, refitting, and end-of-life recycling. All phases need to address decarbonization. In this context, market-based measures such as carbon pricing can motivate a new era of shipbuilding that accelerates the transition to a low-carbon and zero emissions maritime sector.

- **Operational Value Chain:** The maritime operational value chain covers the steps of ships being operational in their activities. Hence, seaports are also a crucial part of the operational chain. Ports need to support, and have the possibility to accelerate, decarbonization in shipping through infrastructure for storing and bunkering of alternative fuels and onshore power supplies.

**Thus, it is necessary to engage stakeholders associated with the shipping sector, and ensure they are working towards the establishment of strategic partnerships and common goals.**

**Value Chains and Selected Decarbonization Enablers**




(**Source and illustration: Mikael Lind and Wolfgang Lehmacher, 2022**)

# Decarbonization Measures & Opportunities at Ports

Several measures can be implemented individually as well as collectively to aid in the reduction of GHG emissions. Some of the measures would be applicable each time a ship calls a port (e.g. simultaneous operations, pre-clearance), while others may be applicable less frequently but can have a large impact on fuel consumption . These measures include but are not limited to:

01 **Facilitate immobilization at ports**

02 **Facilitate hull and propeller cleaning at ports**

03 **Facilitate simultaneous operations in ports**

04 **Optimize port stay by pre-clearance**

05 **Improve ship/berth compatibility through improved Port Master Data**

06 **Greening port equipment and vehicles**

07 **Enable ship deadweight optimization**

08 **Optimize speed between ports**

09 **Digitalization of port operations**

It should be noted that in all cases, measures to reduce GHG emissions in the ship-port interface will require a triangular collaboration (between ships, ports and terminals) and that none of these measures can be implemented by one stakeholder alone.

# Bahrain's Maritime Decarbonization Strategies

The Government have set clear objectives and specific milestones related to the National Sustainable Development Goals ( SDGs 2030 ) in which the PMA has set two initial strategies:

## Strategic Goal #1

**Develop policy instruments for promoting Green Shipping Infrastructure in the Kingdom**

### Key Initiatives

- Regulating fossil fuel consumption within the sector
- Adopt international legislations governing GHG emissions
- Invest in green shipping infrastructure
- Transparency on $CO_2$ emissions across the sector.
- Communicate with stakeholder to align decarbonization goals.

## Strategic Goal #2

**Lead decarbonization of ports towards net zero $CO_2$ emissions by 2040**

### Key Initiatives

- Increase energy efficiency
- Co innovating with customers and suppliers
- Shifting to biofuels
- Improving asset management and utilization
- Offsetting carbon emissions
- Conversion of the KBSP port operations to Solar Power
- Invest in technologies

# Thank you

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