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Scoping Paper for the Caribbean Region **Assessing the Technical Elements of the IMO GHG Strategy**

Prepared For :
Caribbean Shipping Lanes (CSL)

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SCOPING PAPER FOR THE CARIBBEAN REGION: ASSESSING THE TECHNICAL ELEMENTS OF THE IMO GHG STRATEGY

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Abbreviations

AC	Alternating Current
ADB	Asian Development Bank
BESS	Battery Energy Storage System
BL&P	Barbados Light & Power Company
CARICOM	Caribbean Community
CCREEE	Caribbean Centre for Renewable Energy and Energy Efficiency
CCSA	Caribbean Climate Smart Accelerator
C-SERMS	Caribbean Sustainable Energy Roadmap and Strategy
CSR	Corporate Social Responsibility
DC	Direct Current
ECPA	Energy and Climate Partnership of the Americas
EEDI	Energy Efficiency Design Index
EEOI	Energy Efficiency Operational Indicator
EEZ	Exclusive Economic Zone
EREC	Eight Rivers Energy Company
FCUs	Flexible Compliance Units
FLOW	Floating Offshore Wind
FSRUs	Floating Storage and Regasification Units
GCF	Green Climate Fund
GEF	Global Environment Facility
GFS	Goal-based Fuel Standard
GHG	Greenhouse Gas
GIBs	Green Investment Banks
GPA	Grenada Ports Authority
HFO	Heavy Fuel Oil
IEA	International Energy Agency
IMO	International Maritime Organization
IMSF&F	International Maritime Sustainable Fuels and Fund
INDC	Intended Nationally Determined Contribution
IRENA	International Renewable Energy Agency
ISWG	Intersessional Working Group on Reduction of GHG Emissions from Ships
kWh	Kilowatt Hours
LDCs	Least Developed Countries
LNG	Liquefied Natural Gas
m	Meter
MARPOL	International Convention for the Prevention of Pollution from Ships
MDO	Marine Diesel Oil
MEP	Maritime Economy Plan
MEPC	Marine Environment Protection Committee
MGO	Marine Gas Oil

MLC	Maritime Labour Convention
MRE	Marine Renewable Energy
MSP	Marine Spatial Planning
MW	Megawatt
MWp	Megawatt peak
NAPs	National Action Plans
NDC	Nationally Determined Contributions
NIH	National Institutes of Health
NOP	National Ocean Policy
NREL	National Renewable Energy Laboratory
NSF	National Science Foundation
OSW	Fixed Offshore Wind
OTEC	Ocean Thermal Energy Conversion
P4G	Partnering for Green Growth and the Global Goals 2030
PPA	Power Purchase Agreement
PPPs	Public-Private Partnerships
PV	photovoltaic
SEEMP	Ship Energy Efficiency Management Plan
SIDS	Small Island Developing States
SOLAS	International Convention for the Safety of Life at Sea
STCW	Standards of Training, Certification, and Watchkeeping
TTW	Tank-to-Wake
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VAWT	Vertical Axis Wind Turbines
VLSFO	Very Low Sulfur Fuel Oil
WSC	World Shipping Council
WTW	Well-to-Wake
WWF	World Wide Fund for Nature

EXECUTIVE SUMMARY

The International Maritime Organization's (IMO) 2023 Revised GHG Reduction Strategy presents both significant challenges and opportunities for the Caribbean region. The strategy aims to reduce greenhouse gas emissions from shipping, which could lead to increased shipping costs but also encourage economic diversification and growth.

The Caribbean plays a pivotal role in the global maritime industry primarily due to its strategic location. Apart from its proximity to important shipping lanes, the region plays a role in the energy supply chain for liquid fuels with its well-developed storage infrastructure. While not a major consumer of fuel itself, a high amount of fuel trading activity occurs in the region as it serves as a critical logistical hub that connects fossil fuel production in the United States with larger demand centers in Europe and South America. As a key transit point, the Caribbean acts as a warehousing and distribution center for traditional liquid fuels including crude oil, gasoline, diesel, fuel oil and gas oil, before they are re-exported to these higher demand markets. As a result, the Caribbean functions as a key energy transshipment point, with established large scale storage facilities facilitating efficient distribution.

Therefore, despite its relatively small market size, the Caribbean's logistical importance cannot be understated as evidenced by several private-sector investments in fuel storage terminals in the region. The major storage hubs in the Caribbean include St. Croix, St. Eustatius, St. Lucia, and Trinidad and Tobago with a combined crude and fuel storage capacity of 58 million barrels.

Table 1. Fuel Storage Hubs in the Caribbean

Location	Facility Name	Capacity	Ownership
St. Croix	Ocean Point	32 million bbls	Private
St. Eustatius	GTI Statia	14 million bbls	Private
St. Lucia	Buckeye	10 million bbls	Private
Trinidad & Tobago	Paria	2 million bbls	State owned

From these locations, fuel is purchased by private trading companies for distribution to the smaller islands of the Northern and Eastern Caribbean. This break bulk service provided by these traders enables efficient delivery across the region.

Several key regional fuel trading companies including Trafigura, Vitol, BP, Shell

Antilles, Rubis, Atlantic, and Paria (among others) play an essential role in this supply chain. They operate fleets of vessels that transport fuel to and from these central storage hubs. This well-established distribution network, while primarily designed for traditional fuels, presents a significant opportunity for the Caribbean to leverage its existing infrastructure in the global energy transition.

As the world shifts toward cleaner energy sources, the Caribbean is well-positioned to play a strategic role in the distribution of emerging green fuels such as biofuels, hydrogen, ammonia, and methanol. The region's proximity to major biofuel production centers in the U.S. and Brazil, coupled with existing ammonia and methanol storage and production capabilities in Trinidad and Tobago, makes it a natural hub for sustainable fuel distribution.

The region's existing storage infrastructure in St. Croix, St. Eustatius, St. Lucia, and Trinidad and Tobago can be adapted to accommodate biofuels. However, these facilities must undergo upgrades, including cleaning and dedicating storage tanks and flow lines to prevent contamination from fossil fuel residuals previously held in these tanks.

Trinidad and Tobago is among the top five (5) global exporters of ammonia and methanol, which are two (2) fuels expected to be critical in the evolution of the maritime sector. With significant storage infrastructure already in place, the country is well-suited to serve as a regional hub for these fuels. However, current production relies on natural gas, necessitating investment in renewable energy to produce green hydrogen for sustainable ammonia and methanol production.

St. Kitts, Nevis, and Dominica possess substantial geothermal energy potential, which can support the production of green hydrogen. This hydrogen can then be used to produce green ammonia and methanol, which can be sent to Trinidad and Tobago to leverage its storage and distribution infrastructure.

Despite the Caribbean's potential to become a key player in sustainable fuel distribution, significant investments in infrastructure and financial support from international agencies will be required. These include:

- **Infrastructure Upgrades**: Existing fuel storage facilities must be adapted for biofuels, and maritime fleets that transport fuel will also need on board modifications, cleaning or dedication of storage tanks to handle new fuel types.
- **Investment in Renewable Energy**: The transition to green hydrogen production for ammonia and methanol will require substantial investment in renewable energy sources such as solar, wind, and geothermal.
- **Local Demand Center Readiness**: While islands like Trinidad and Tobago may serve as supply hubs, other Caribbean nations must make

independent investments and gain the appropriate certifications to prepare for receiving ammonia, methanol and biofuels into their respective onshore storage tanks.

- **Risk of Limited Regional Adoption**: Without sufficient financial backing, the Caribbean risks remaining dependent on fossil fuels, while foreign companies continue to leverage its strategic position and upgrade existing infrastructure only for distributing green fuels to better-prepared international markets.

Given the Caribbean's strategic position and established energy infrastructure, the region has the potential to play a crucial role in global energy logistics and the shift toward sustainable fuels. However, realizing this opportunity will require a coordinated effort, including infrastructure upgrades, investment in renewable energy, and financial support from international partners. Without these critical steps, the Caribbean may struggle to transition away from fossil fuels, even as it continues to serve as a vital transit hub for global energy markets.

This transformation presents both challenges and opportunities, but with the right financial and institutional support, the Caribbean can position itself at the forefront of the clean energy transition.

1. Study Background

Consistent with international efforts to mitigate climate change, the IMO has identified comprehensive strategies which are to be implemented in support of global sustainability targets. Following the commencement of deliberations in 2011, an initial approach was articulated in 2018, with the most recent iteration of these frameworks, agreed in 2023, reinforcing the adoption of alternative fuels and technologies such that international shipping can achieve net-zero GHG emissions by 2050. Several intermediate targets have been established, and to ensure consistent movement towards achieving these targets, multiple technical assistance and capacity building initiatives have also been established.

Several structures have been established within the IMO to facilitate the development and implementation of actions required to achieve the intermediate and end-point targets. Key discussions among two such groups – the Intersessional Working Group on Reduction of GHG Emissions from Ships (ISWG) and the Marine Environment Protection Committee (MEPC) are scheduled for early 2025. These negotiations are consistent with the long-term scheduled approved by the IMO, and will establish the means by which the proposed global targets will be achieved. Once instituted as part of the International Convention for the Prevention of Pollution from Ships (MARPOL) – part of the formal regulations governing global shipping practices – the agreed technical and economic measures will have a direct impact on shipping and related activities well into the future. Such changes will significantly affect maritime operations worldwide, having repercussions for Small Island Developing States (SIDS) which are particularly vulnerable to the direct and indirect impacts from climate change, as well as operational changes in the maritime sector.

Given the potential implications of the IMO decisions, it is important for the Caribbean region to be appropriately supported to allow for active and effective engagement during these negotiations. This Consultancy is intended to provide background information that can inform negotiation positions that reflect the region's interests and challenges. This includes the technical elements of the negotiations, the region's current capabilities, and actionable recommendations, such that the region's positions are reflected in the agreements emanating from the negotiations, and that importantly, the Caribbean remains appropriately positioned to access the capacity building and technical assistance required to prepare for the long-term changes which will define the future maritime industry.

2. Overview of the IMO GHG Strategy

2.1. Vision and Targets

The expressed vision of the IMO is the achievement of net-zero GHG emissions from international shipping, ensuring a just and equitable transition by or around 2050. The 2023 IMO GHG Strategy is built on three pillars:

- contributing to international efforts at GHG mitigation – i.e. achieving alignment with the requirements of the Paris Accord and UN 2030 Agenda;
- identifying actions required by the international shipping sector and addressing country impacts; and
- identifying related actions, measures and incentives to realize agreed outcomes.

To achieve these objectives, four (4) interlinked ambitions have been established:

- **Improvement of Energy Efficiency for New Ships**: Strengthening the design requirements for new vessels.
- **Carbon Intensity Reduction**: Achieve at least a 40% reduction in carbon intensity of international shipping by 2030, relative to 2008 levels.
- **Uptake of Zero or Near-Zero Emission Technologies**: Ensure that zero or near-zero GHG emission technologies and fuels comprise at least 5%, striving for 10% of the energy used by international shipping by 2030.
- **Net-Zero Emissions Goal**: Attain net-zero GHG emissions from international shipping by or around 2050.

The ten (10) year Quantitative Targets are as reflected in Table 2 following:

Table 2: Ten-Year Quantitative Targets as outlined by the IMO Technical Measures

Year	Target
2030	At least 20% reduction in annual GHG emissions (striving for 30%), compared to 2008 levels. Uptake of Zero/Near-Zero GHG emission technologies, fuels and/or energy sources by at least 5% (striving for 10%).
2040	At least 70% reduction in annual GHG emissions (striving for 80%), compared to 2008 levels.
2050	Achieve net-zero emissions.

Source: Developed from IMO

2.2. Measures

Prior to the Initial IMO Strategy of 2018, measures had already been introduced to respond to concerns about sustainability in the maritime sector. In 2011, the Energy Efficiency Design Index (EEDI) became mandatory for new ships, and the Ship Energy Efficiency Management Plan (SEEMP) was introduced for all ships. The EEDI improves efficiencies at the design stage by specifying incrementally higher minimum energy efficiency levels per capacity mile, without dictating the

technologies to achieve alignment with the standard. The SEEMP focuses on operational efficiencies, whereby fleet operators focus on considerations such as planning and maintenance to improve performance aboard vessels, integrating tools such as the Energy Efficiency Operational Indicator (EEOI) which can provide data to support and fine-tune optimization efforts. Guidelines on Technical and Operational Measures were also instituted to support the mandatory regulations.

Following agreement on the 2018 Strategy, short-term measures, largely driven by the work of MEPC were finalized and agreed between 2018 and 2023 (see **Appendix I**), with a review of the short-term GHG reduction measures scheduled to be completed by January 2026.

Building on the revised 2023 IMO GHG Strategy, medium-term options with the associated dates for entry into force are to be agreed by 2025, with other candidate mid-term GHG reduction measures expected to be finalized and agreed by MEPC between 2023 and 2030, inclusive of the dates of entry into force. The basket of candidate measures which deliver on the reduction targets include both goal-based marine fuel standards regulating the phased reduction of the marine fuel's GHG intensity (the technical element) and an economic element, based on a maritime GHG emissions pricing mechanism.

The five (5) broad areas are as follows:

- **Emissions Measurement Scope**: This considers the boundaries to be applied in attributing emissions to fuels. The initial 2018 Strategy was based on a Tank-to-Wake (TTW) principle, whereas the revised 2023 strategy considers a Well-to-Wake (WTW) approach that recognizes emissions along the full value chain from feedstock to ship discharge. An alternate option for defining the GHG intensity of candidate fuels includes 'TTW with Sustainability Criteria' – a hybrid mechanism that initially focuses on shipboard emissions, but eventually widens to include upstream feedstock inputs,
- **Goal-based Fuel Standard (GFS)**: This limits the emissions per unit of energy, as expressed by an established formula. Considerations would include continuous revisions to such a standard so as to ensure the migration to more environmentally friendly options,
- **Penalties for failing to meet the GFS**: This determines the cost of noncompliance, structured in such a manner as to increase the attractiveness of transition,
- **GFS trading mechanisms**: Establishment of a mechanism that allows for the trade of 'certificates' where vessels that achieve intensities below the established target can bank such surpluses and have them available to vessels unable to access fuels meeting the standard, and
- **GHG pricing**: This will consider a direct cost on each unit of GHG emitted onboard, which can then be redirected to support R&D for sustainable marine

fuels and technologies efforts, or impact mitigation efforts in vulnerable jurisdictions.

2.3. Key Discussion Points

There is general consensus on the GFS as a mechanism for initiating the adoption of near-zero and zero-emissions fuels. There is also an appreciation that the impact of such a standard on the adoption of near-zero and zero-emission fuels would be accelerated when complemented with a pricing mechanism. However, there are differing views on the methodology for incorporating the flexibility mechanism which provides multiple pathways for compliance. While in general, the current proposals will allow a credit/certificate system that facilitates offsets between over-performing and under-performing vessels:

- EU countries favour Flexible Compliance Units (FCUs)
- Other jurisdictions led by Argentina favour Remedial Units
- The International Chamber of Shipping prefers a voluntary compliance mechanism assessed across a pool of ships and,
- Other proponents are amenable to a fee payment

With respect to the pricing mechanisms, three (3) major categories have evolved:

- A feebate mechanism that sets a flat-rate contribution per unit of emission emitted, with a partial rebate consistent with the quantity of eligible zero or near-zero fuels being used by a ship
- A global levy determined by all GHG emissions produced by international shipping – preferred by Caribbean nations such as Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Jamaica and St. Lucia to ensure that all emitters contribute fairly to emission reduction. The funds generated from this levy could support climate adaptation and mitigation efforts within SIDS and Least Developed Countries (LDCs)
- Hybrid approaches that include competing proposals from the International Maritime Sustainable Fuels and Fund (IMSF&F) which is suggesting a pooling, banking and fund contribution/reward for both over-compliant and under-compliant ships, whereas the World Shipping Council (WSC) prefers a “Green Balance Mechanism” which envisages fees being applied to ships burning fossil fuels and allocated to ships using green fuels

2.4. Implementation Schedule

The timeline established by the IMO for the adoption and enforcement of the approved measures is as follows:

- April 2025 (MEPC 83): Approval of mid-term measures and agreement on MARPOL amendments
- October 2025: Formal adoption of the measures at an extraordinary session of MEPC
- 2027: Entry into force of the adopted measures.

2.5. Stakeholder Implications

Ultimately, achieving the targets outlined in the 2023 IMO GHG Emissions Reduction Strategy requires coordinated and sustained action. The intent is to drive innovation around zero-emissions technologies and fuels, leading to a reduction in emissions. Achieving clarity on the policy measures and dates for entry into force reduces uncertainties which impact decision making (including in investments) across the industry. This is because of the multitude of stakeholders with vested interests and other interested parties that are associated with the negotiation process, including inter alia:

- IMO Member States that will be responsible for implementing the approved strategy through national regulations and policies,
- Shipping Companies whose operations will be directly affected because of the need to adapt to new emission reduction measures,
- Ship Owners who must make decisions regarding ship design and fuel choices to comply with the approved strategy,
- Environmental Organizations which advocate for strong emission reduction targets and will be part of the compliance monitoring process,
- Industry Associations that represent the interests of shipping companies and work to develop practical solutions for meeting the IMO's goals,
- Financial Institutions that will fund the multiple investment activities required to facilitate the transition, and can influence outcomes through their lending practices,
- Energy Sector Players who must develop and supply low-carbon fuels to the maritime industry, and
- Equipment Manufacturers and Suppliers who will be required to design and produce innovations that improve the efficiencies of existing assets, or create new outputs capable of contributing to the agreed standards.

2.6. Likely Outcomes from IMO Mid-Term Negotiations

One of the major impacts of the IMO 2023 GHG Strategy will be on the energy mix in the maritime sector. Traditional fuels associated with higher emissions intensity (Heavy Fuel Oil (HFO), Marine Diesel Oil (MDO), Very Low Sulfur Fuel Oil (VLSFO)

and Liquefied Natural Gas (LNG)) will be progressively phased out in favor of near-zero or zero emissions options. These will include:

- Green Methanol – A promising alternative as it can be produced from renewable sources (biomass or green hydrogen) and has a lower carbon footprint.
- Green Ammonia – A zero-carbon fuel when produced using renewable energy, though safety and infrastructure challenges remain.
- Green Hydrogen – Which offers zero emissions, but current challenges include storage, handling, and the need for specialized ship engines.
- Biofuels (e.g., Biodiesel, Bio-LNG, Bio-Methanol) – Can serve as drop-in replacements for fossil fuels and have lower lifecycle emissions.

2.7. Projected Demand

In order to arrive at the desired end-state, the near-zero or zero emissions fuels will be adopted in phases given current capacities and the need for further development of technologies to be able to utilize the fuels. By 2030 it is anticipated that 5-10% of the global marine energy mix would be from alternative near-zero or zero emissions fuels, with demand estimated at 20-40 million tonnes annually. By 2040, the share of near-zero or zero emissions fuels in the energy mix is likely to increase to 35-50% globally, equating to a demand of 200-300 million tonnes annually. By 2050 the expectation is that 100% of marine fuel should be carbon-neutral in order that net-zero emissions targets are achieved, requiring more than 500 million tonnes of green fuels to be available annually.

Near-term action will see an increased demand for methanol, biofuels, and LNG blends due to availability and compatibility with the existing technologies aboard vessels. Consistent with the proposed transition timeline and the impacts of the carbon pricing mechanisms and associated regulations, by 2040 the dominant fuels are expected to be green ammonia, green methanol, green hydrogen, and advanced biofuels, with green hydrogen and green ammonia expected to be the primary fuels in long-term scenarios, supplemented by synthetic e-fuels and wind/solar-assisted propulsion.

2.8. Implications for Transition and Long-term Changes

There will be multiple global challenges associated with the required transition. Almost simultaneously, there will need to be efforts directed towards:

- rapidly scaling the production of green hydrogen, green methanol, and green ammonia,

- retrofitting and developing the supply chains, and storage and bunkering at port facilities to handle ammonia, hydrogen, and biofuels,
- developing and implementing appropriate safety protocols and regulations for handling fuels such as ammonia and hydrogen, which have their specific characteristics, and
- structuring and instituting policies and incentives which can accelerate cost reductions for green fuels, thereby making them more competitive with fossil fuels.

3. The Regional Scenario

3.1. Background

Maritime transport plays a key role within the Caribbean, impacting employment, infrastructure and general economic activity. Two (2) of the world's largest flag States – Panama and The Bahamas – are located in the Caribbean basin, and due to its strategic geographic location, the Region plays an important role in the international shipping industry, where it:

- facilitates trade between North and South America,
- acts as a key transit point for global maritime trade because of its proximity to the Panama Canal and the associated East-West global trade routes, and
- commands over 60% of the world's cruise market

The region also has a critical role to play in the global supply chain for liquid fuels, serving as a logistical hub connecting fossil fuel production in the United States with larger demand centers in Europe and South America. Therefore, in addition to the implications resulting from the application of regulations approved as part of the IMO mid-term GHG strategy, the existing warehousing and distribution landscape for traditional fuels including crude oil, gasoline, diesel, fuel oil and gas oil will be drastically altered by the transition to near-zero and zero-emissions fuels. This is critical, given the speed at which this transition is required in order to meet the IMO GHG aspirations.

Approved regulations resulting from the upcoming IMO negotiations will thus affect a wide swath of actors, including:

- existing fossil fuel energy producers supplying the maritime sector
- value-chain actors supporting the servicing of vessels directly (considering the current bias towards WTW approach by the IMO)
- value-chain actors supporting logistics requirements outside of the Caribbean
- potential green energy suppliers and green derivative producers

3.2. Energy, Renewable Energy, and Sustainable Development Policies in Selected Caribbean Nations

Several countries within the region have articulated policies related to the achievement of global sustainability targets. Some have progressed further in seeking to align national policies with specific maritime requirements as outlined in Table 3 following:

Table 3: GHG Emission Reduction Policies and Frameworks for the Caribbean

Country	GHG Strategy Commitments	Types of GHG	Key Measures of Implementation	Initiatives
Antigua & Barbuda	IMO-aligned GHG reductions, conditional decarbonization strategies	Not specified	Enforcing energy efficiency measures; Auditing compliance; Modernizing port facilities; Adopting wind energy	National Ocean Policy (NOP) integrating Marine Spatial Planning (MSP); Legislative updates to align with climate goals; Centre of Excellence for Oceanography and the Blue Economy; Green Climate Fund
Dominica	44.7% reduction in GHG emissions by 2030 (compared to 2014), net-zero emissions by 2050	Not Specified	Implementing EEDI, EEXI, and CII standards; renewable energy (100% by 2030 using geothermal resources); tax incentives for electric and hybrid vehicles	Climate Resilience and Recovery Plan 2020-2030; public awareness campaigns; expansion of protected forests
Grenada	40% reduction in GHG emissions by 2030 (compared to 2010)	Methane	Sector-specific investment plans; 30% reduction in emissions from electricity production; 20% reduction in transport emissions by 2025; 90% reduction in methane emissions from Waste Management Sector	Protecting at least 17% of terrestrial area; The Territorial Sea and Maritime Boundaries Act, The Grenada Ports Authority (GPA), The Maritime Economy Plan (MEP), The NOP
Guadeloupe	EU's "Fit for 55" targets, including ETS for maritime transport, carbon neutrality by 2050	Not specified	Transitioning port facilities to renewable energy; Investments in alternative fuels like LNG and zero-emission solutions; Shore power infrastructure; EEXI and CII compliance	Cáyoli Project (solar power, waste recycling, cleaner tech); Green corridors; Green hydrogen infrastructure; Mangrove and coral reef restoration

Country	GHG Strategy Commitments	Types of GHG	Key Measures of Implementation	Initiatives
Guyana	Not specified in terms of GHG target Focus on maintaining status as a net carbon sink	Not specified	Modernizing maritime legislation to align with IMO best practices; ISPS compliance; Focus on renewable energy and forest conservation	Twenty-two (22) ports compliant with ISPS code
Jamaica	IMO GHG reduction strategies; MARPOL Annex VI commitments	SOx, NOx, particulate	Implementing EEDI and SEEMP; Port development with modernized infrastructure, LNG integration, and renewable energy; Transitioning from heavy fuel oil to LNG	Targets 50% renewable energy in electricity generation by 2030; Adoption of alternative fuels such as LNG, biodiesel blends and ultra-low sulfur diesel
Martinique	EU's "Fit for 55" Package, IMO GHG Strategy targets	Not specified	Integrating solar and wind power into port operations; Advancing energy storage technologies	Regional collaboration for shared decarbonization practices; 100% renewable electricity by 2030
Montserrat	IMO GHG Strategy targets (50% emission reduction by 2050); MARPOL Annex VI energy efficiency standards	Not Specified	Aligns with international and regional frameworks; Benefits from international capacity-building initiatives, and regional collaborations	Use of the IMO Ship Emissions Toolkit to develop sustainable maritime practices
Saint Lucia	16% reduction in GHG emissions by 2025 and 23% reduction by 2030 (compared to projected business-as-usual levels)	CO2 equivalent	National legislation and international conventions (SOLAS, MARPOL, STCW)	Focus on safety, environmental protection, and crew training
St. Vincent and The Grenadines	Not explicitly stated in terms of GHG target	Not Specified	Framework of maritime policies to regulate waters and ensure safety, while promoting sustainable use of marine resources	Maritime Areas Act (1983); Fisheries Act (1986); Maritime Labour Convention (MLC 2006)

Country	GHG Strategy Commitments	Types of GHG	Key Measures of Implementation	Initiatives
Suriname	Nationally Determined Contributions (NDC) outline specific strategies for emission reduction; Focuses on maintaining carbon sinks	Not specified	Protecting at least 17% of its terrestrial area by 2030; Transition to renewable energy sources; Cost-reflective tariff structure to promote energy efficiency; Expansion of mitigation activities in Agriculture and Transport	MARPOL and STCW ratification; Marine protected areas project
Trinidad and Tobago	30% reduction in public transport emissions; 15% overall emissions reductions	Not specified	Guided by the National Maritime Policy and Strategy	Maritime policies designed to create a robust framework for sustainable development of the maritime industry

Figure 1 following reflects some key insights to the several policy approaches being pursued within the Region.

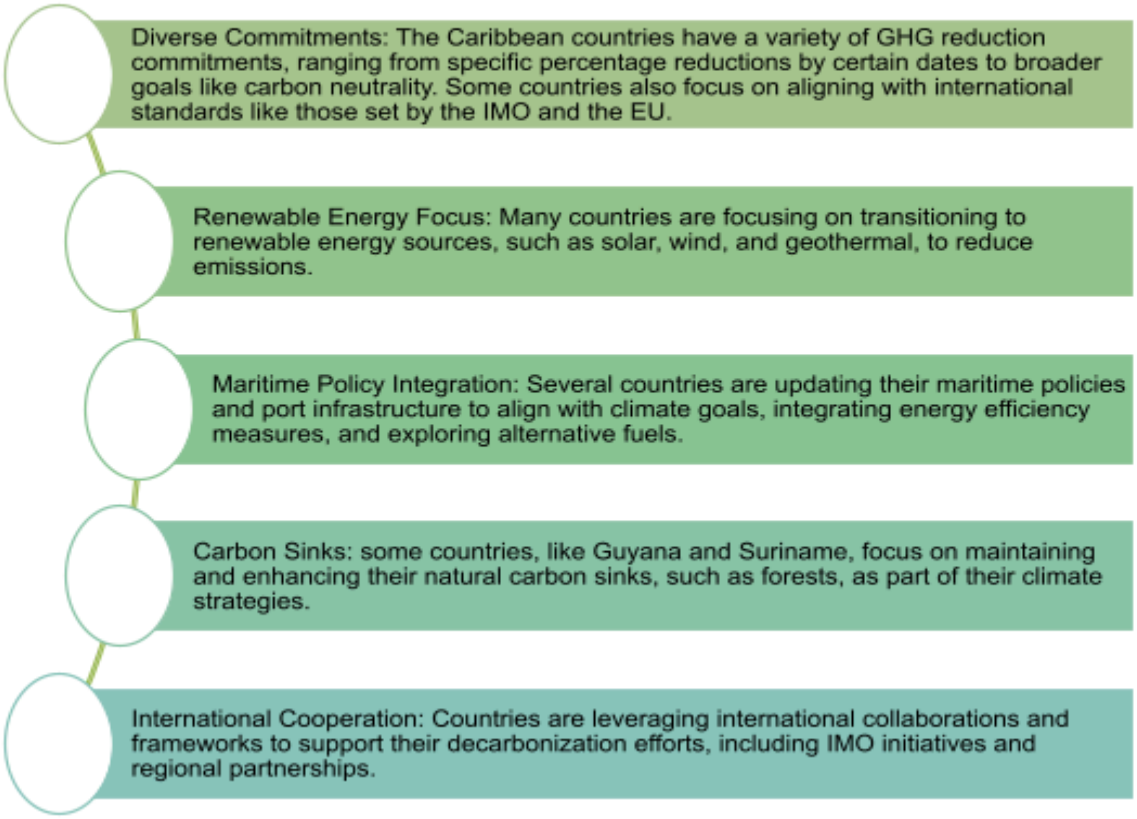

Figure 1: Key Insights into Regional Sustainability Policy Responses

A cursory look at the various initiatives and their status suggests inconsistency in these national policies, whereas alignment and coordinated regional action is desirable. There is also a need to ensure that policies are not only consistent among countries, but also aligned with the direction of the IMO framework.

This extends to structured approaches for engaging shipping companies to incentivize investment in green technologies, either in the infrastructure within the region, or in the vessels that are utilized for transport within and through the region. There is potential for engagement given the role of the region's shipping lanes, the existing infrastructure, and the presence of major flag states. Left unattended, there is significant exposure where the existing policy gaps create an opportunity for suboptimal outcomes where the region cannot transition and develop in a manner that matches the IMO aspirations, and thus is negatively impacted on multiple fronts as implementation presses ahead.

3.3. Key Challenges and Gaps

Beyond the policy concerns, there are several additional areas which require attention.

3.3.1. Fuel Consumption

The Caribbean relies primarily on HFO, VLSFO and Marine Gas Oil (MGO) for shipping. According to the International Energy Agency, the region consumes approximately 5-7 million tonnes of maritime fuel annually, with the bulk of demand emanating from cruise ships, cargo vessels, and regional ferries.

3.3.2. Fuel Supply Chains

The Caribbean faces significant challenges in its fuel supply chains, primarily due to high import dependency, fragmented supply networks, and natural disaster vulnerability. Most nations in the region lack indigenous fossil fuel resources and rely heavily on imports, making them susceptible to global price volatility, supply chain disruptions, and geopolitical risks. The dispersed geography of islands further complicates logistics, increasing the cost and complexity of fuel distribution and infrastructure development. Additionally, the region is highly vulnerable to hurricanes and other extreme weather events, which frequently disrupt supply chains, leading to shortages and price spikes.

3.3.3. Infrastructure

Most Caribbean ports require substantial upgrades to meet modern fuel and energy needs. Many ports are not equipped to handle the storage and distribution of emerging fuel types which are essential for the transition to cleaner energy. The development of specialized bunkering facilities is necessary to support alternative fuel-powered vessels and align with global green shipping initiatives. Additionally, the establishment of green corridors, designated routes prioritizing sustainable practices and low-emission technologies, is crucial to achieving a reduction in GHG emissions in the maritime industry. To address these challenges, ports must also invest in resilient infrastructure capable of withstanding climate-related risks such as hurricanes, flooding, and rising sea levels, ensuring uninterrupted operations and long-term sustainability.

3.3.4. Technological Capacity

The Caribbean's maritime sector faces significant technological challenges in aligning with global advancements in energy efficiency and the adoption of alternative fuels. Many vessels in the region are outdated, with limited energy-efficient features, resulting in higher operational costs and increased GHG emissions. Addressing this gap requires substantial investments in retrofitting existing ships with technologies such as optimized propulsion systems, hull modifications, and energy-saving devices. Additionally, the region must prioritize the

development and acquisition of new vessels designed to utilize zero-emission fuels like hydrogen, ammonia, etc. However, this transition is hindered by high upfront costs, and a lack of supporting infrastructure, such as bunkering facilities and storage for alternative fuels.

As an example, six (6) Caribbean islands – Jamaica, Antigua and Barbuda, Dominica, Martinique, Guadeloupe, and Montserrat are exploring diverse renewable energy options for their maritime sectors. Each island leverages its unique resources, such as geothermal energy in Dominica and Guadeloupe, wind energy in Antigua and Barbuda, and solar energy across multiple islands, to electrify ports and support the adoption of alternative fuels like LNG and hydrogen (see Table 5 following).

Table 4: Application of Renewable Energy Options to the Maritime Sector in Selected Caribbean Countries

Country	Renewable Energy Options	Alternative Fuel Technologies	Opportunities
Jamaica	Solar and Wind Energy, Hydropower	LNG	Port Electrification, LNG Bunkering Services
Antigua & Barbuda	Solar Energy, Wind Energy (400 MW potential, especially in Barbuda)	No alternative fuel technology mentioned	Renewable-Powered Ports, Regional Wind Energy Development
Dominica	Geothermal Energy (over 100 MW potential), Solar and Wind Energy (5.6 kWh/m²/day solar, 30 MW wind potential)	Hydrogen and E-fuels	Geothermal-Powered Ports, Hydrogen Development
Martinique	Biomass Energy, Solar Energy	Hydrogen	Hydrogen Bunkering, Biomass for Port Operations
Guadeloupe	Geothermal Energy, Solar and Wind Energy	No alternative fuel technology mentioned	Geothermal Expansion for port electrification
Montserrat	Solar Energy (with battery storage), Geothermal Energy (1-2 MW initial capacity, scalable)	No alternative fuel technology mentioned	Renewable Ports, Blue Economy Integration

Opportunities focus on creating regional hubs for cleaner marine fuels, developing shore power systems, and integrating renewable energy into broader blue economy initiatives like sustainable fishing and tourism. The goal is to reduce reliance on fossil fuels, decrease carbon emissions from maritime activities, and enhance the sustainability of port operations. Such initiatives represent initial efforts toward decarbonizing the Caribbean's maritime industry and fostering regional cooperation on clean energy development. However, they must be coordinated and aligned to be complementary to each other and minimize unnecessary duplication.

4. Opportunities for Caribbean Involvement in Framework Strengthening

Given the high impact potential for the Caribbean region due to its heavy maritime reliance, there are several avenues along which the region will have to direct its focus so as to successfully mitigate changes in the sector. With the myriad of stakeholders and their comparative influence, contributions with the potential to shape the IMO frameworks should be directed as part of the SIDS network, given likely commonalities, and negotiating power as a group.

A critical aspect should be on accessing resources to support the transitional elements of the strategy, and to develop long-term capacity for the continued changes likely in the maritime sector over the coming decades. The IMO emphasizes a "just and equitable transition" for SIDS, including capacity-building initiatives and targeted financing. Ensuring SIDS' involvement in decision-making processes is vital for their contribution to global GHG reduction goals. As a result, considerable efforts should be targeted on mechanisms which support the "just and equitable transition" either directly through the IMO, or facilitated by the Organisation, so that there is a pool of resources (in the broadest sense) available to support the SIDS such as those in the region, as reflected in Figure 2 following:

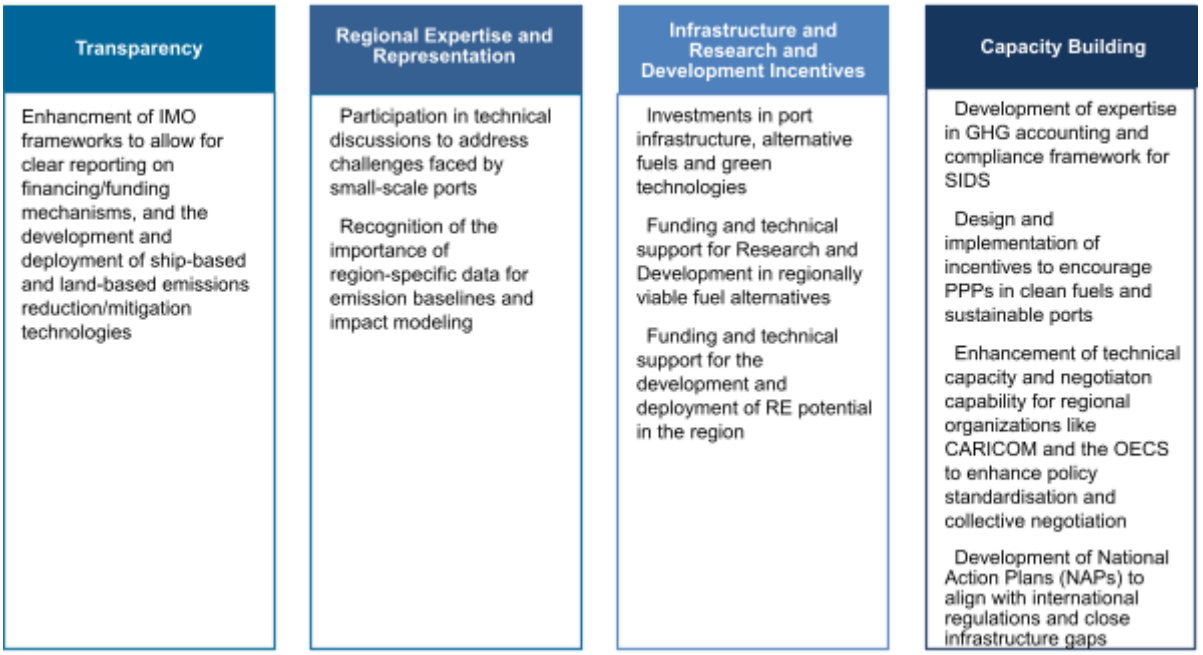

Figure 2: Indicative Opportunities for Caribbean Contributions

The areas of greatest potential value for the Caribbean is in securing concessions/funding/support for Infrastructure and Research and Development Incentives and Capacity Building. These components best position the region to

begin early implementation of initiatives to improve core capacities related to its role as a logistical hub. Indeed, the region also has an opportunity to become a producer of zero or near-zero GHG emission fuels, so that simultaneously there is strengthening of the economic capacity to address other gaps related to the transition of the maritime sector, and to build resilience into other existing economic structures.

4.1. Support for Emissions-compliant Fuel Demand

By 2030, the Caribbean will require an estimated **10-15 million tonnes** of fuels annually, with LNG, biofuels, and green methanol playing a major role during this transition period. Specifically:

- In the short-term (2025-2030), LNG adoption is expected to reach 15-20% of the Caribbean's maritime fuel market, with biofuels projected to contribute 5-10%,
- In the medium-term (2030-2040) there is anticipated to be an expansion of hydrogen and ammonia fuel infrastructure driven by a projected 30-50% reduction in HFO and MGO dependency, and
- In the long-term (2040-2050) there will be the development of net-zero shipping corridors between Caribbean ports and major trade partners, with a concomitant 70-100% adoption of green fuels for intra-regional shipping.

These changes will have a domino effect on several areas, and the region does not have the range of expertise or financial resources to appropriately address the multiple requirements across these areas. It is therefore important that direct or indirect mechanisms are articulated in the proposed mid-term measures that ensure financial and technology transfer support.

Table 5 following reflects the access to, availability and cost of alternative fuels in the Caribbean.

Table 5: Access, Availability and Costs of Alternative Fuels in the Caribbean

Region	Access and Availability				Cost
	LNG	Hydrogen	Methanol	Ammonia	
Jamaica	Jamaica has established LNG infrastructure operated by New Fortress Energy. LNG is used for power generation and could be extended to	Hydrogen infrastructure for maritime use is non-existent. There are no active projects to produce or utilize hydrogen in this sector.	Methanol is not available for maritime use in Jamaica. No projects are underway to integrate methanol into the energy or maritime sectors.	Ammonia is not currently produced or accessible for maritime applications.	LNG: Competitively priced compared to HFO and MGO due to established infrastructure reducing importation costs.

Region	Access and Availability				Cost
	LNG	Hydrogen	Methanol	Ammonia	
	maritime bunkering. LNG is the most accessible alternative fuel for maritime applications in Jamaica.				Hydrogen, Methanol, Ammonia: High costs due to the absence of infrastructure and economies of scale.
Antigua & Barbuda	The Antigua Power LNG Terminal, nearing operational status, will provide LNG for power generation and potentially for marine bunkering.	Hydrogen infrastructure is not available, and no projects are focused on maritime applications.	Methanol is not accessible, and no plans for maritime integration exist.	Ammonia is not available or under consideration for maritime use.	LNG: Costs are expected to be lower than diesel with the new terminal, though limited scale and early-stage infrastructure could drive up initial costs Hydrogen, Methanol, Ammonia: Prohibitively high costs due to limited or no infrastructure and lack of market demand.
Dominica	No LNG facilities or projects exist, leaving Dominica reliant on imported diesel.	Hydrogen is not accessible, and there are no plans for its production or maritime use.	Methanol is not available or integrated into the energy landscape.	No ammonia production or usage infrastructure exists.	All Fuels: High costs due to reliance on small-scale diesel imports and lack of alternative fuel infrastructure.
Montserrat	Montserrat has no LNG infrastructure or projects, relying exclusively on diesel.	No hydrogen infrastructure or projects are in place for maritime or energy applications.	Methanol is not accessible and not prioritized.	Ammonia is not available for maritime use.	All Fuels: High costs due to small-scale fuel imports and the absence of alternative fuels infrastructure.
Martinique	Project Bonnie, developed by Gasfin and EDF, provides	A waste-to-hydrogen project by Ways2H	Methanol is not widely available but could benefit	Ammonia infrastructure does not exist, though	LNG: Competitively priced due to EU subsidies

Region	Access and Availability				Cost
	LNG	Hydrogen	Methanol	Ammonia	
	LNG infrastructure through Floating Storage and Regasification Units (FSRUs), supporting power generation with potential for maritime use.	Inc. aims to convert local waste into renewable hydrogen. While primarily for power generation, it could potentially support future maritime applications.	from EU-supported renewable energy initiatives.	it could be considered under future renewable energy strategies.	and shared infrastructure with Guadeloupe. Hydrogen, Methanol, Ammonia: High costs due to limited production and infrastructure.
Guadeloupe	Similar to Martinique, Guadeloupe is part of Project Bonnie, with shared LNG infrastructure for power generation and potential maritime use.	Hydrogen is not accessible for maritime use, though future projects may emerge under EU renewable energy frameworks.	Methanol is not available or widely supported for maritime applications.	No ammonia production or maritime infrastructure exists.	LNG: Costs are reduced by shared infrastructure with Martinique and EU subsidies. Hydrogen, Methanol, Ammonia: Costs remain high due to the absence of infrastructure and market demand.

4.2. Support for E-fuels and Policy Requirements

E-fuels like e-ammonia, which is produced using renewable energy and green hydrogen, are critical for decarbonizing long-haul shipping. Their adoption depends on investment in electrolysis, storage, and distribution infrastructure. Only a few Caribbean countries have policies supporting e-fuels, and this is critical for aligning with the long-term shift anticipated for intro-regional shipping stations and storage hubs. Leveraging these policies, for example:

- Jamaica, with policies supporting renewable energy development (including green hydrogen) and e-fuels could develop Kingston as a hub for e-ammonia refueling, using its strategic location in the northern Caribbean,
- Trinidad and Tobago, with policies supporting renewable energy development (including green hydrogen), could develop as a hub for e-ammonia production and refuelling using its strategic location as a transshipment point for South America, and

- Dominica: with its proposed investment in green ammonia production from geothermal energy, could develop as a hub for e-ammonia production and refueling using its strategic location in the Eastern Caribbean.

Reports by IRENA and IEA highlight e-ammonia as a viable alternative. Guadeloupe and Martinique, with EU support, are well-positioned to spearhead regional production efforts given their existing experience with green hydrogen production, while other jurisdictions develop the robust renewable energy capacity required for scaling production of these fuels. Regional cooperation is also necessary to establish production facilities, shared supply chains, and training programs for port operators, standardization and policy framework development.

4.2.1. Fuel Infrastructure

Major bunkering hubs include Jamaica (Kingston), Trinidad and Tobago, the Bahamas, and Curaçao. However, there is limited infrastructure for alternative short-term fuel options such as LNG, Methanol, and biofuels at these facilities. Options for addressing these gaps include:

- Leveraging Trinidad and Tobago's LNG expertise to develop a regional bunkering hub, given World Bank estimates that setting up LNG bunkering hubs cost approximately US$500-US$800 million per major port. This approach minimises heavy investments in infrastructure that will not provide fuels relevant to the long-term trajectory of requirements,
- Utilizing regional agricultural waste for biofuel production, and
- Prioritising investment in electrolysis and ammonia production for future-proof fuel supply.

Biofuels in Shipping

The transitional role of bioenergy needs to be assessed in a Caribbean context given its inclusion in the fuel-mix projections for the maritime sector. Biofuels have more recently been touted as a short- term alternative as they can be used as "drop-in" fuels – meaning they can replace conventional marine fuels without requiring significant modifications to existing engines. This characteristic is advantageous as it allows for a smoother transition to more sustainable energy sources. Policies such as Jamaica's NDC and CARICOM's energy framework highlight biofuel development as part of their broader focus on renewable energy and sustainable practices, creating an opportunity for future adoption in the maritime sector. Feedstock availability and regional collaboration are key enablers.

From a production standpoint, countries like Jamaica, Martinique have substantial potential for biofuel production from crops such as sugarcane and oil palm. Estimates indicate that with improved agricultural practices and technology, these nations could significantly increase their biofuel output – potentially producing billions of litres of ethanol and biodiesel annually. Additionally, many neighboring Latin America countries such as Cuba, and Dominican Republic can also be potential biofuel production stations.

However, there are risks to environmental sustainability of expanded feedstock production, and the economic risks of diverting crops from food to fuel production need to be comprehensively evaluated. Additionally, from a bunkering perspective where the Caribbean is required to service external demand, the "drop-in" reference relates to use in existing engines, not necessarily transmission and distribution infrastructure, which will themselves require upgrades. Certain segments of the shipping industry, such as passenger vessels and cruise lines, may well find biofuels more economically viable due to stricter emissions regulations and public demand for sustainability, creating niche markets where biofuels become competitively priced relative to fossil fuels, and thus will have to be accommodated to ensure the region's relevance to the shipping industry.

4.2.2. Supply Chains

The region lacks large-scale production capacity for traditional fuels, which creates logistical bottlenecks and increases vulnerability to price volatility. Existing inefficiencies will simply be transferred as implementation of the IMO Strategy requires more and more near-zero and zero emission fuel options. Production capacity will have to be addressed, else the volatility which characterizes the current market and its heavy reliance on fuel imports will simply be migrated and heightened by the prescribed global transition.

4.2.3. Port Upgrades

Upgrading general port infrastructure is critical for accommodating new energy demands and enhancing shipping efficiency. For example, while renewable energy technologies are becoming more cost-effective, challenges remain regarding their integration into existing grids. There is also a need for upgrades to improve resilience to climate change.

4.3. Support for Renewable Energy Development

The total primary energy demand across Latin America and the Caribbean is projected to be at least 80% higher by 2040. Specifically, electricity needs are

expected to grow by over 91%, necessitating an additional 1,500 TWh to meet the region's requirements. The availability of renewable energy can influence efforts to reduce maritime emissions in multiple areas.

As reflected in Figure 3 following and at **Appendix II**, several Caribbean island-nations including Trinidad and Tobago, St. Lucia, St. Vincent and the Grenadines, St. Kitts and Nevis, and Barbados are exploring opportunities whereby each island can leverage its unique resources such as offshore wind, solar, geothermal, hydropower, and biomass, to reduce reliance on fossil fuels and promote sustainability. These initiatives involve integrating renewable energy into port operations, developing alternative marine fuels, and transitioning to electric or hybrid vessels. Government policies and investments are required to actively support these transitions, aiming to enhance energy security, reduce emissions, and boost economic growth.

The Case Studies presented at **Appendix III** provide references to the successful delivery of investments in RE in selected SIDS countries.

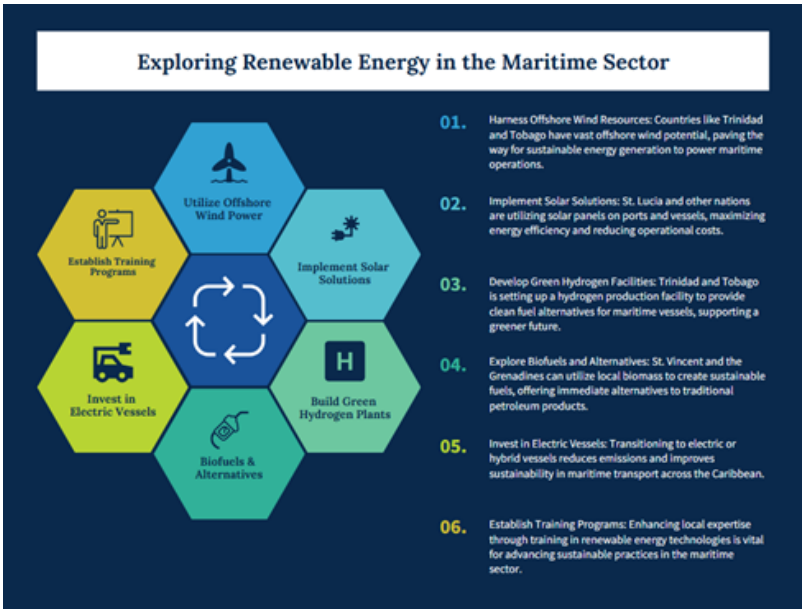

Figure 3: The Role of Renewable Energy in the Maritime Sector

4.4. Support for Financing

International climate financing is critical for supporting developing countries in their adaptation and mitigation efforts against climate change. Various mechanisms exist:

4.4.1. Multilateral Funds

Green Climate Fund (GCF): Provides grants and concessional loans to support adaptation and mitigation projects in developing countries. Proposals can receive funding up to USD 25 million.
Global Environment Facility (GEF): Offers grants for projects that address global environmental issues, including biodiversity loss and climate change.

4.4.2. Bilateral Funding

Countries often engage in bilateral agreements to provide financial assistance for climate initiatives. This can include Grants and Loans, including concessional loans that offer favorable terms compared to market rates.

4.4.3. Private Sector Investments

Private investments play a crucial role in funding climate-related projects. This includes Green Bonds – issued by governments or corporations to raise funds specifically for environmentally friendly projects and Corporate Social Responsibility (CSR) Initiatives, where entities fund sustainability projects as part of their CSR strategies.

4.4.4. Innovative Financing Mechanisms

These mechanisms aim to mobilize additional resources for climate action:

- Carbon Trading: Market-based approaches that allow for the buying and selling of carbon credits.
- Climate Resilience Bonds: Financial instruments designed to fund projects that enhance resilience against climate impacts.

4.4.5. Additional Funding Opportunities

Several non-traditional sources have also developed:

- Government Grants: Agencies like the National Science Foundation (NSF) and National Institutes of Health (NIH) provide substantial funding for research aligned with national priorities
- Philanthropic Organizations: These entities often support niche research areas that may not attract government or corporate funding
- Crowdfunding Platforms: Individual researchers can seek funding through platforms dedicated to scientific research.

4.4.6. Public-Private Partnerships (PPPs)

Several promising Public-Private Partnerships (PPPs) are emerging as significant funding avenues for climate change research. PPPs are collaborative agreements between government entities and private sector companies aimed at financing projects that serve the public interest. They are particularly relevant in infrastructure

and climate-related projects and can be integrated in several areas, such as encouraging private investment in renewable energy-based fuel production and expanding financing mechanisms for sustainable port infrastructure projects. Key features include:

- Shared Risk: Both parties share the financial risks and rewards associated with the project.
- Investment Leverage: PPPs can leverage private investment to supplement public funding, enhancing project viability.
- Innovative Financing Structures: These may include blended finance models that combine grants, loans, and equity investments.

There are several examples of PPPs in Climate Finance including the Green Infrastructure Finance Framework, which is a framework that evaluates how green projects can be structured and financed, integrating public support with private investment to create bankable projects. Governments can establish National Green Funds that solicit international support for greenhouse gas concessional funding, enabling broader participation in climate initiatives.

These partnerships leverage resources, expertise, and innovation from both the public and private sectors to address climate challenges effectively, with some notable examples being included at **Appendix IV**. Given the financial constraints impacting the region, and the substantial investments required for the transition of the maritime industry, directed support in establishing related frameworks for accessing and leveraging PPPs will be useful and timely for the region. This includes establishing guidelines that reflect the crucial role of Government in facilitating PPPs (see **Appendix V**).

5. Conclusion

The Caribbean maritime sector faces significant challenges in transitioning to low-carbon and zero-emission fuels. Notwithstanding, fundamental changes are required, since the maritime sector is heavily relied upon for both trade and tourism. The region also has a strategic role to play in global maritime operations due not only to its geographic location, but also its renewable energy potential.

There will be multiple impacts from the implementation of approved IMO proposals:

- Increased shipping costs: The transition to zero-emission fuels and technologies will likely raise operational costs for shipping, potentially increasing freight rates. This would disproportionately affect the Caribbean, where many nations are net importers.
- Investment requirements: The shift to green shipping will require investment in new technologies, port infrastructure, and alternative fuel production. While the Caribbean could become a hub for green fuel production using its strategic location, the dispersed nature of the islands complicates fuel distribution and infrastructure development, increasing costs and complexity.
- Economic Diversification and Growth: The IMO strategy promotes renewable energy sources and alternative fuels, potentially diversifying the economic base of Caribbean countries. The transition could create jobs in new industries like renewable energy and alternative fuel production, diversifying the labor market.

These impacts will have to be mitigated by well designed and implemented interventions. Several priority actions are required, such as:

- adopting zero-emission technologies early and focusing on green corridors for economic and energy security benefits;
- exploring local green fuel production via renewable energy hubs, to reduce reliance on imported fuels;
- fostering energy independence through mapping and pursuing major port infrastructure investments:
    - fuel storage, bunkering and distribution, and
    - resilient green port infrastructure (electrification of port facilities and equipment) and electric vessels;
- integrating renewable energy across sectors so as to capture emissions over the entire lifecycle of fuels, ensuring the comprehensive GHG reductions required under the more expansive Well to Wake approaches for emissions mitigation; and

- leveraging existing or tailored financial mechanisms, and promoting new/innovative options (such as public-private partnerships) to fund the substantial investments required for all aspects of the transition.

These present significant opportunities for the region to align with the IMO's GHG reduction targets while promoting sustainable economic growth and climate resilience.

Specific recommendations include:

- Developing and implementing regulatory frameworks that support GHG reductions in maritime operations, whereby IMO regulations are integrated into national legislation and National Action Plans (NAPs) tailored to reducing sector emissions by promoting green fuel adoption and enhanced port infrastructure,
- Strengthening of regional cooperation to establish shared infrastructure, develop common standards, and leverage collective bargaining power in international negotiations,
- Increased investment in education and training programs to build capacity and expertise in GHG accounting, compliance, the operation of new technologies, as well as seafarer training,
- Obtaining favorable access to expanded financial mechanisms and international financial support, including grants and concessional loans, as well as innovative financing like green bonds, and
- Incentivizing research and development in alternative fuels and energy-efficient technologies.

The region, and other SIDS must lobby intensely to ensure that funding and resources are made available either directly by the IMO or by third-parties through the intercession of the IMO, allowing access to the inputs which facilitate the "just transition" and allow for active and successful participation in the associated processes and long-term viability of the sector.

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Appendix I – Timeline of Actions: Revised 2023 IMO GHG Strategy

OVERVIEW OF PREVIOUS WORK UNDERTAKEN BY THE ORGANIZATION TO ADDRESS GHG EMISSIONS FROM SHIPS

An overview of IMO work undertaken to address GHG emissions from ships is provided below:

.1 MEPC 62 (July 2011) adopted resolution MEPC.203(62) on *Inclusion of regulations on energy efficiency for ships in MARPOL Annex VI* introducing mandatory technical (EEDI) and operational (SEEMP) measures for the energy efficiency of ships;

.2 MEPC 65 (May 2013) adopted resolution MEPC.229(65) on *Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships*, to provide technical assistance to Member States to enable cooperation in the transfer of energy efficient technologies, in particular to developing countries;

.3 MEPC 67 (October 2014) approved the Third IMO GHG Study 2014, estimating that GHG emissions from international shipping in 2012 accounted for some 2.2% of anthropogenic CO_2 emissions and that such emissions could grow by between 50% and 250% by 2050;

.4 MEPC 70 (October 2016) adopted, by resolution MEPC.278(70), amendments to MARPOL Annex VI to introduce the data collection system for fuel oil consumption of ships, containing mandatory requirements for ships to record and report their fuel oil consumption, and also adopted the *Road map for developing a comprehensive IMO strategy on reduction of GHG emissions from ships* (the Road Map). Ships of 5,000 gross tonnage and above (representing approximately 85% of the total GHG emissions from international shipping) are required to collect consumption data for each type of fuel oil they use, as well as other, additional, specified data including proxies for "transport work";

.5 MEPC 72 (April 2018) adopted, by resolution MEPC.304(72), the *Initial IMO Strategy on Reduction of GHG Emissions from Ships*, setting out a vision which confirmed IMO's commitment to reducing GHG emissions from international shipping and to phasing them out as soon as possible, and agreed to keep the Initial Strategy under review, with a view to adoption of a Revised Strategy in 2023;

.6 MEPC 73 (October 2018) approved the *Programme of follow-up actions of the Initial IMO Strategy*, intended to be used as a planning tool in meeting the timelines identified in the Initial IMO Strategy;

.7 MEPC 74 (May 2019) approved MEPC.1/Circ.855 on *Procedure for assessing the impacts on States of candidate measures*; adopted resolution MEPC.323(74) on *Inviting Member States to encourage voluntary cooperation between the port and shipping sectors to contribute to reducing GHG emissions from ships*, as revised by MEPC 79 by resolution MEPC.366(79); and agreed to establish a voluntary multi-donor trust fund ("GHG TC-Trust Fund"), to provide a dedicated source of financial support for technical cooperation and capacity development activities to support the implementation of the Initial IMO Strategy on Reduction of GHG Emissions from Ships;

.8 MEPC 75 (November 2020) adopted resolution MEPC.327(75) on *Encouraging Member States to develop and submit voluntary National Action Plans to address GHG emissions from ships*, as revised by MEPC 79 by resolution MEPC.367(79); approved the Fourth IMO GHG Study 2020; and adopted, by resolution MEPC.324(75), amendments to MARPOL Annex VI advancing and strengthening EEDI Phase 3 requirements for several ship types;

.9 MEPC 76 (June 2021) adopted, by resolution MEPC. 328(76), amendments to MARPOL Annex VI introducing the short-term GHG reduction measure containing a technical Energy Efficiency Existing Ship Index (EEXI), an operational Carbon Intensity Indicator (CII) and an enhanced Ship Energy Efficiency Management Plan (SEEMP); adopted a series of seven technical guidelines supporting the EEXI and CII frameworks; approved a *Work plan to progress development of mid- and long-term GHG reduction measures in line with the Initial IMO Strategy on Reduction of GHG Emissions from Ships and its Programme of follow-up actions*;

.10 MEPC 77 (November 2021) agreed to initiate the revision of the *Initial IMO Strategy on Reduction of GHG Emissions from Ships*, recognizing the need to strengthen the ambition during the revision process; and adopted resolution MEPC.342(77) on *Protecting the Arctic from shipping Black Carbon emissions* recognizing that Black Carbon was a potent short-lived contributor to climate warming; and

.11 MEPC 78 (June 2022) adopted a series of 10 technical guidelines to support the implementation of the short-term GHG reduction measure;

.12 Council 128 (November 2022) endorsed the finalized terms of reference of a Voluntary Multi-Donor Trust Fund to Facilitate the Participation of Developing Countries, Especially Small Island Developing States (SIDS) and Least Developed Countries (LDCs) in IMO GHG Meetings, and agreed to review the terms of reference, based on the experience of the first full year of operations of the Fund, no later than at the 130th session of the Council;

.13 MEPC 79 (December 2022) adopted amendments to MARPOL Annex VI to revise the data collection system for fuel oil consumption for the implementation of the EEXI and the CII framework, approved a *Revised procedure for assessing the impacts on States of candidate measures* (MEPC.1/Circ.885/Rev.1) and adopted resolutions MEPC.366(79) and MEPC.367(79) on *Invitation to Member States to encourage voluntary cooperation between the port and the shipping sectors to contribute to reducing GHG emissions from ships* and *Encouragement of Member States to develop and submit voluntary National Action Plans (NAPs) to address GHG emissions from ships*, respectively; and

.14 MEPC 80 (July 2023) adopted resolution MEPC.376(80) on *Guidelines on life cycle GHG intensity of marine fuels* (LCA guidelines); initiated the comprehensive impact assessment of the basket of candidate mid-term measures; and adopted resolution MEPC.377(80) on *2023 IMO Strategy on Reduction of GHG Emissions from Ships* (2023 IMO GHG Strategy).

Appendix II – Selected Summaries on Sustainability Efforts

Trinidad and Tobago

- Offshore Wind Energy: Trinidad and Tobago has significant potential for offshore wind energy generation, estimated at up to 25 GW within its Exclusive Economic Zone (EEZ). Developing offshore wind farms could provide a sustainable energy source for maritime operations. The government aims to achieve 30% of electricity from renewable sources by 2030.
- Solar Energy: The country is focusing on integrating solar photovoltaic (PV) energy into port operations and marine services to enhance energy efficiency. There is also a proposed 112-Megawatt solar project.
- Green Hydrogen Production: Trinidad and Tobago is developing its first carbon-neutral hydrogen production facility, which can serve as a clean fuel alternative for maritime vessels. Green hydrogen could be used in fuel cells for ships.
- Alternative Marine Fuels: As a major LNG producer, the country is well-positioned to develop a market for LNG as a cleaner fuel option for shipping.
- Energy Storage Solutions: Investment in battery assembly and manufacturing projects can support the integration of renewable energy into maritime operations.
- Manufacturing Renewable Energy Components: Trinidad and Tobago aims to become a manufacturing hub for components related to solar and wind energy technologies.
- Marine Services and Training: The development of training programs focused on renewable energy technologies can enhance local expertise in sustainable practices within the maritime sector.

St. Lucia

- Solar Energy Utilization: St. Lucia can leverage solar energy by installing solar panels on port facilities, ships, and marine infrastructure. The island has significant solar potential, estimated at 36 MW.
    - Solar installations can power lighting, refrigeration, and other operational needs at ports.
    - Solar panels could be integrated into ship designs to supplement energy needs during operations.

- Geothermal Energy Development: St. Lucia has an estimated geothermal resource potential of about 680 MW, which could be harnessed to provide a stable power source for maritime activities.
    - Geothermal plants could supply electricity to port facilities and support electrification of vessels.
    - Geothermal energy could be used in desalination processes to support freshwater needs.
- Wind Energy Applications: St. Lucia can explore wind energy with an estimated potential of 42 MW.
    - Offshore or nearshore wind turbines can provide clean energy for port operations.
    - Combining wind with solar systems can create a more resilient energy supply.
- Biofuels and Alternative Fuels: Developing biofuels from local biomass can serve as an alternative fuel for vessels.
    - Utilizing agricultural waste or dedicated energy crops can create biofuel.
    - Many marine engines can be adapted to run on biofuels.
- Energy Storage Solutions: Implementing battery storage systems is crucial for balancing the intermittent nature of renewable energy sources.
    - Microgrids powered by renewable sources with integrated storage can enhance resilience.
    - Storage systems can provide backup power for critical maritime operations during emergencies.
- Electric Vessels: Investing in electric or hybrid vessels can reduce emissions.
    - Electric ferries or water taxis could lower operational costs and emissions.
    - Establishing charging stations at ports would support the growth of electric vessels.

St. Vincent and the Grenadines

- Hydropower Utilization: The country has three (3) operational hydropower plants, which can be leveraged to support maritime operations. There is also potential for additional hydropower generation.
- Solar Energy Integration: Solar PV systems can be implemented at maritime facilities, and offshore solar farms are a possibility.

- Geothermal Energy Development: St. Vincent has significant geothermal resources, estimated between 100-890 MW. Partnerships with private companies could develop geothermal plants for maritime activities.
- Wind Energy Opportunities: Wind energy has high deployment potential, and establishing wind farms near coastal areas could supply renewable energy to maritime operations. Wind-assisted propulsion technologies could also be developed.
- Biofuels and Alternative Fuels: Importing biofuels can provide an immediate alternative to petroleum products, and local production of biofuels can be encouraged.
- Electric and Hybrid Vessels: Transitioning to electric or hybrid vessels for inter-island transport can reduce emissions, and establishing charging stations at ports will be crucial.
- Policy Support and Investment: The government is committed to achieving 60% renewable energy. Collaborating with international organizations can provide financial and technical assistance.

St. Kitts and Nevis

- Microgrid Implementation at Ports: A renewable energy-powered microgrid is being installed at the Basseterre Deep Water Port, incorporating Vertical Axis Wind Turbines (VAWT) and solar energy systems.
- Solar Energy Development: The potential for solar PV systems is significant, especially given the high costs of fossil fuels. Solar energy can be used for electricity and powering vessels and port operations.
- Wind Energy Utilization: Advanced turbine technology can provide a sustainable solution for maritime operations. The existing wind power plant on Nevis demonstrates the feasibility of wind energy.
- Geothermal Energy Potential: Geothermal energy is a viable option with lower levelized costs compared to fossil fuels.
- Biofuels and Waste-to-Energy: Developing biofuels from organic waste can create sustainable fuel sources. Waste-to-energy technologies can also help manage waste.
- Electric and Hybrid Vessels: Transitioning to electric or hybrid vessels can reduce emissions, and investments in charging infrastructure at ports would support this.
- Challenges: There is a need for local expertise in renewable technologies, increased financial investment, and strengthening public-private partnerships.

Barbados

- Marine Renewable Energy (MRE) Technologies:
    - Fixed Offshore Wind (OSW): Has been identified as a priority option due to its reliability and capacity for large-scale energy production.
    - Floating Offshore Wind (FLOW): Offers flexibility in location and can be deployed in areas with higher wind speeds.
    - Ocean Thermal Energy Conversion (OTEC): Suitable for tropical regions like Barbados.
    - Wave Energy: Ongoing research could lead to future developments.
- Biomass and Waste-to-Energy: Utilizing organic waste materials can help reduce landfill use while generating energy.
- Solar Energy Expansion: There is potential for expanding solar applications in maritime contexts.
- Electric and Hybrid Maritime Transport: Exploring electric ferries or hybrid vessels can reduce reliance on fossil fuels.
- Regulatory Support and Investment: The government is actively working on regulatory frameworks to attract investment in renewable energy projects.
- Blue Economy Initiatives: Barbados aims to integrate renewable energy into its blue economy strategy.

Appendix III – Case Studies showcasing synergies realized from RE investments

Case Study 1: Tonga's Largest Solar Power Plant

Background

Tonga, a South Pacific island nation, has historically relied heavily on imported diesel for electricity generation, with approximately 87% of its power coming from fossil fuels. This dependency led to high electricity costs and significant greenhouse gas emissions. Recognizing the environmental and economic vulnerabilities of this energy model, Tonga committed to achieving 70% of its electricity from renewable sources by 2030.

Initiatives

Tonga launched a 6 MW solar power plant in Tongatapu, which became the largest solar installation in the South Pacific. The initiative was supported by the Asian Development Bank (ADB), Tonga Power Limited, and Sunergise New Zealand Ltd. The project included the development of three (3) interconnected solar arrays.

Implementation

The government of Tonga signed a 25-year agreement with Sunergise for the plant's operation and maintenance. Despite disruptions caused by the COVID-19 pandemic and the volcanic eruption of 2022, the project was successfully commissioned in December 2022. The funding package also included grants and concessional loans to minimize the financial burden on the local economy.

Outcome

The project significantly reduced Tonga's reliance on diesel, stabilized electricity costs, and lowered greenhouse gas emissions. It also demonstrated resilience in the face of natural disasters and showcased the potential of public-private partnerships in advancing renewable energy in SIDS.

"South Pacific's largest solar power plant opens in Tonga," SEANZ, accessed January 31, 2025, https://www.seanz.org.nz/south_pacific_s_largest_solar_power_plant_opens_in_tonga

Case Study 2: Samoa's Renewable Energy Transition

Background

Samoa has faced growing energy demands coupled with high dependence on imported fossil fuels. To address these challenges, the government adopted the

Samoa Energy Sector Plan (2017–2022), which aimed to achieve 100% renewable energy in electricity generation by 2025.

Initiatives
Several initiatives were implemented under this plan:

1. Hydropower Revitalization: Rehabilitation of aging hydropower plants funded by the ADB and the European Union.
2. Solar Energy Projects: Construction of a 2 MW solar farm supported by the UAE-Pacific Partnership Fund and deployment of smaller solar systems in remote areas.
3. Battery Energy Storage: Installation of a battery energy storage system (BESS) in 2019 to stabilize the grid and integrate intermittent renewables.
4. Biogas Production: Introduction of the Samoa Biogas Initiative, which converted agricultural waste into renewable energy

Implementation
These projects were made possible through international financial and technical assistance, with active collaboration between public and private stakeholders. Community consultations ensured local buy-in and participation, while capacity-building programs provided the skills needed to operate and maintain renewable energy systems.

Outcome
By 2022, renewable energy accounted for over 50% of Samoa's electricity generation. The transition reduced carbon emissions, improved rural energy access, and supported job creation. Samoa's approach serves as a model for aligning national policies with international partnerships.

"Accelerating Samoa's green energy transition," UNDP, accessed January 31, 2025, https://www.undp.org/samoa/stories/accelerating-samoas-green-energy-transition

Case Study 3: Jamaica's Eight Rivers Energy Solar Power Plant

Background
Jamaica's energy sector has historically depended on imported petroleum, which accounts for over 90% of its energy mix. In response to volatile oil prices and environmental concerns, Jamaica set a goal to achieve 50% renewable energy by 2030.

Initiatives
The Eight Rivers Energy Company (EREC) project established a 37 MW (51 MWp) solar photovoltaic plant in Paradise Park, Westmoreland. Developed by Rekamniar

Frontier Ventures and Neoen, the project included a 20-year Power Purchase Agreement (PPA) with the Jamaica Public Service Company.

Implementation
The USD 65 million project was financed through private investments and included significant community involvement. Solar training programs were introduced for local residents, and construction created job opportunities for nearby communities. The plant was commissioned in June 2019, delivering electricity at 8.5 US cents per kWh, the lowest cost for renewable energy in Jamaica.

Outcome
The plant generates 82,000 MWh annually, reducing Jamaica's reliance on imported oil and lowering carbon emissions. It also contributed to local economic development through skills training and job creation.

"Case Study: Eight Rivers Energy Company 37MW (50MWp) Utility Solar PV Plant in Jamaica," Rekamniar, accessed January 31, 2025, https://www.rekamniar.com/case-study-eight-rivers-energy-company/

Case Study 4: Barbados Light & Power's Solar Plant in St. Lucy

Background
Barbados, like other SIDS, is vulnerable to the impacts of climate change and heavily reliant on imported fossil fuels. As part of its commitment to renewable energy, Barbados set a target to become 100% renewable by 2030.

Initiatives
The St. Lucy Solar PV Plant is a 10 MW (DC) / 8 MW (AC) solar farm developed by Barbados Light & Power Company (BL&P). The project included a Tesla Powerpack energy storage system to improve efficiency and reliability.

Implementation
The USD 20 million project was constructed by Grupotec, a Spain-based EPC provider. It integrated advanced battery storage systems to address intermittent generation issues. Community engagement ensured that local workers were employed during the construction phase.

Outcome

The plant generates 20.2 GWh annually, reducing CO2 emissions by 21,000 tons and improving energy security. It also set a precedent for utility-scale solar projects in the Caribbean and highlighted the importance of integrating storage solutions in renewable energy systems.

“Power plant profile: Saint Lucy Solar PV Park, Barbados,” Power Technology, accessed January 31, 2025, https://www.power-technology.com/data-insights/power-plant-profile-saint-lucy-solar-pv-park-barbados/

“First Utility Scale Solar Farm (10 MW) in Barbados,” Solar Barbados, accessed January 31, 2025, https://www.solarbarbados.com/2019/05/09/first-utility-scale-solar-farm-10mw-in-barbados/

Appendix IV – Promising Public-Private Partnerships

P4G Partnerships

- Overview: P4G (Partnering for Green Growth and the Global Goals 2030) focuses on accelerating public-private partnerships for sustainable development.
- Funding Opportunities: P4G offers funding of up to $100,000 for start-up partnerships and up to $1 million for scale-up partnerships aimed at innovative solutions in sectors like energy, water, and circular economy.
- Impact: In recent years, P4G has facilitated numerous partnerships that demonstrate market success and replicability in developing countries.

Global Innovation Lab for Climate Finance

- Overview: This initiative aims to drive private investment into low-carbon, climate-resilient projects in developing countries.
- Achievements: The Lab has mobilized over $1.28 billion in sustainable investments by identifying and supporting transformative finance ideas.
- Focus Areas: It emphasizes collaboration among over 60 institutions to scale up climate finance through innovative financial instruments.

Caribbean Climate Smart Accelerator (CCSA)

- Overview: Launched in 2018, CCSA is a collaboration among Caribbean governments, global companies, and financial institutions aimed at fast-tracking investments for climate action.
- Objectives: The CCSA seeks to engage the private sector in executing climate projects and raising funds for blended financial facilities.
- Benefits: This partnership enhances resource mobilization and fosters innovative climate solutions through cross-sector collaboration.

Green Investment Banks (GIBs)

- Overview: GIBs are institutions designed to facilitate investment in green projects by leveraging public funds to attract private investment.
- Functionality: They provide access to concessional capital at lower interest rates, making green investments more attractive.
- Global Examples: Various countries have established GIBs tailored to their specific environmental goals, enhancing the effectiveness of PPPs in climate finance.

Community Development Carbon Fund

- Overview: This fund is a public-private partnership that supports renewable energy and efficiency projects through carbon finance mechanisms.
- Significance: It exemplifies how PPPs can overcome traditional financing limitations by providing a structured approach to funding climate initiatives

Appendix V – Role of Government in facilitating PPPs

Developing Enabling Frameworks

- Policy and Regulatory Support: Governments establish legal and regulatory frameworks that provide long-term stability and predictability for investors. This includes creating specific regulations for PPPs that outline roles, responsibilities, and risk-sharing mechanisms.
- De-risking Investments: By providing guarantees, subsidies, or other forms of financial support, governments can reduce the perceived risks associated with climate investments, making them more attractive to private investors.

Mobilizing Financial Resources

- Public Investment: Governments can invest public funds directly into climate projects or create national climate funds that pool resources for PPP initiatives. This helps to leverage additional private sector financing by demonstrating commitment and reducing risk.
- Innovative Financing Mechanisms: Governments can facilitate the creation of blended finance structures that combine public funds with private investments, enhancing the overall funding available for climate initiatives.

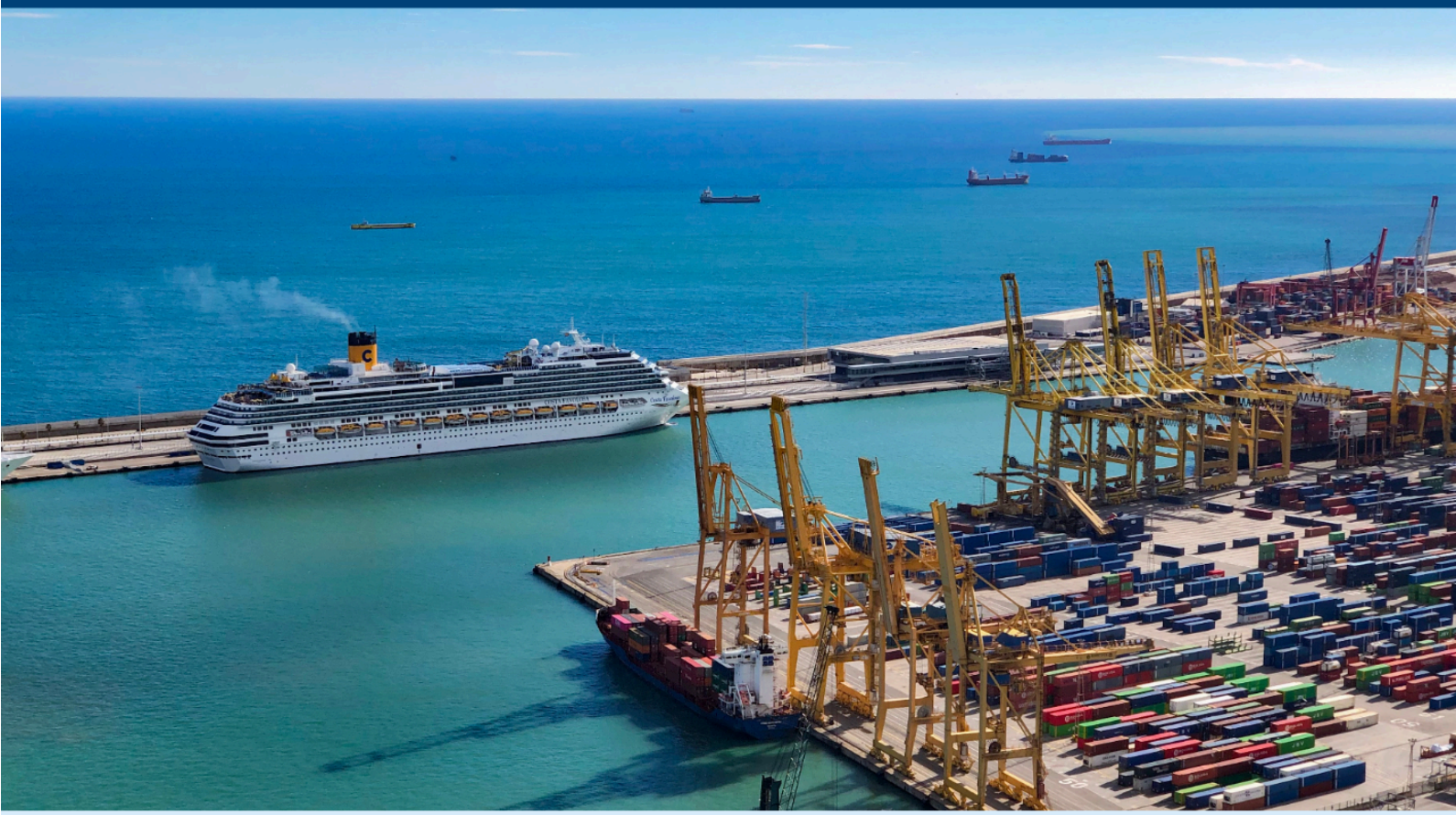
Building Partnerships and Collaboration

- Engagement with Private Sector: Governments actively engage with private companies to identify opportunities for collaboration in climate finance projects. This includes hosting forums, workshops, and consultations to foster dialogue between public and private stakeholders.
- Involvement of Multilateral Development Banks: Governments often collaborate with multilateral development banks to channel funds and expertise into climate projects, which can help attract further private investment through established networks and credibility.

About Caribbean Shipping Lanes

The Caribbean Shipping Lanes (CSL) Project, housed at the Shridath Ramphal Centre, supports the Caribbean's engagement in International Maritime Organization GHG negotiations. With funding from the United Nations Foundation and support from the University College London and the Belize Port Authority, CSL enhances regional coordination, research, and advocacy for sustainable and climate-resilient maritime policies.

https://shridathramphalcentre.com/caribbean-shipping-lanes/



CARIBBEAN SHIPPING LANES