IMO-UNEP-Norway INNOVATION FORUM

Innovation to Support Maritime Decarbonization with Focus on Developing Countries

Background Document

to the 4th IMO-UNEP-Norway Innovation Forum

focussing on Innovation-Enabling Environment pertaining to Maritime Decarbonisation Strategies & Action Plans[1]

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Chapter I: IMO-UNEP-Norway Innovation Forum (2021-2024): An Overview

The Innovation Forum is a partnership between International Maritime Organization (IMO) and United Nations Environment Programme (UNEP) and is supported by the Government of Norway.

The Forum is aimed at championing innovation to accelerate the transition of the marine sector towards a zero- and low-emission future. The Forum strives to achieve this by providing a global platform to exchange best practices and to fill identified gaps by gathering ideas, sharing latest developments & disseminating these amongst a broad array of stakeholders.

The initiative focusses on promotion of inclusive innovation that addresses the specific needs of developing countries, especially the Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

To date, three editions of the Innovation Forum have been held between 2021 and 2023, where the primary focus had been to:

- Showcase green technologies and their deployment globally in a manner that supports the blue economy, particularly in the developing regions,
- Discuss and debate new financing models to fund sustainable maritime transport with inputs from Multilateral Development Banks (MDBs).

The focus of Innovation Forum 2024 is to:

- Examine national, regional and global innovation strategies and models for fostering innovation and cooperation between energy and maritime stakeholders in the context of maritime decarbonization

Purpose of this Background Document

The purpose of this Background Document is three-fold:

1. To summarize the observations and lessons learnt from the past Forums
2. To showcase best practices, lessons learnt in relation to a maritime decarbonization innovation enabling environment, following up on previous Forum's specific recommendations.
3. To provide background and reference material for participants of the 2024 IMO-UNEP-Norway Innovation Forum.

The Background Document will lay out some national case-studies, looking at linkages of National Energy Transition Programs and National Action Plans to address GHG emissions from ships, as well study and list various international collaborations ongoing that aim to reduce maritime GHG emissions.

Finally, it will propose some questions to further stimulate discussions amongst the participants and stakeholders on the key components of an enabling environment for a successful transition to maritime decarbonization.

It will aim to serve through this as a useful background and reference document to participants of the 2024 IMO-UNEP-Norway Innovation Forum, which aims to:

- Analyse innovation and technology cooperation models for sustainable maritime development (building on national, regional and global best practices);
- Showcase national approaches to implement the IMO 2023 GHG Strategy and look at importance of enabling environment on national level;
- Showcase global support to innovation in maritime decarbonization through collaboration and capacity building;
- Address seafarers needs, ensuring a just transition for seafarers;
- Address importance of innovative finance and overall, investments in maritime decarbonization.

Chapter II: Summary Observations & Lessons Learnt of Past Innovation Forums

1. 2023 IMO GHG Strategy is driving the Maritime Decarbonization Agenda

In July 2023 (MEPC 80), the 2023 IMO Strategy on Reduction of GHG Emissions from Ships[2] was adopted, by which Net Zero GHG emission is targeted to be achieved by or around 2050. The indicative checkpoints are 20% to 30% reduction by 2030 and 70% to 80% reduction by 2040.

The 2023 IMO GHG Strategy envisages a reduction in **carbon intensity** (CO_2 emissions per transport work) of international shipping by at least **40% by 2030** (compared to 2008).

The 2023 IMO GHG Strategy also includes a new level of ambition relating to the uptake of **zero or near-zero** GHG emission technologies, **fuels** and/or energy sources which are to represent at least **5%, striving for 10%** of the energy used by international shipping by **2030**.

As carbon emissions from maritime industry today constitute about 3% of global emissions[3] , these policy measures are seen by the industry as quite timely.

2. Maritime Decarbonization Pathway requires a Supportive Ecosystem to Succeed

Broadly speaking, maritime decarbonization pathway has three major components, viz.

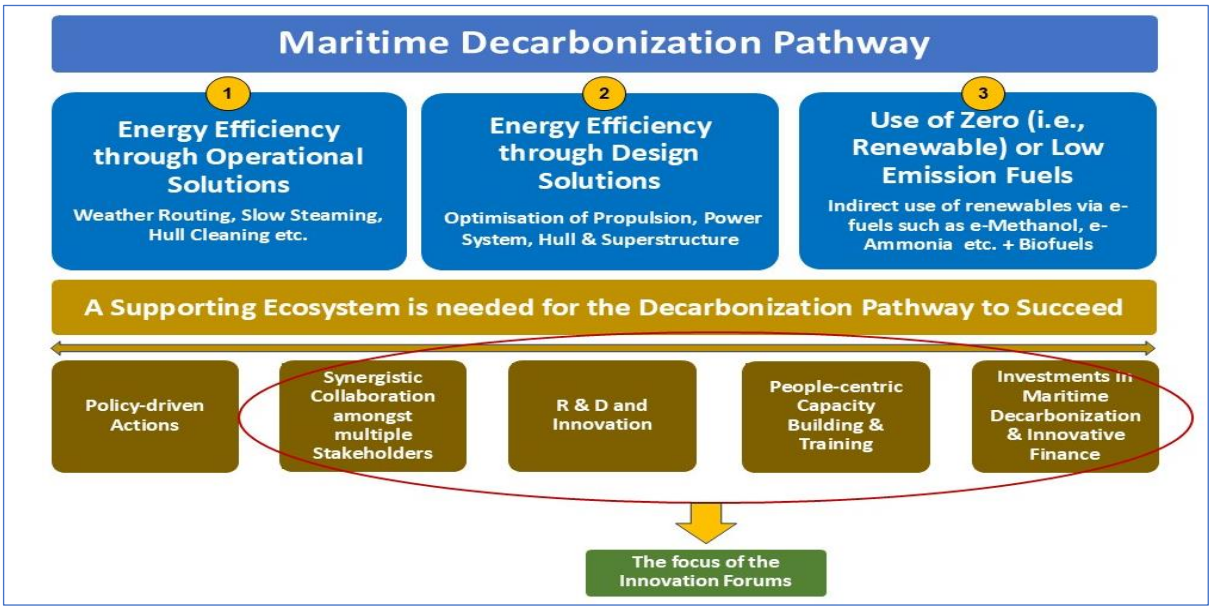
(i) Energy Efficiency through Operational Solutions
(ii) Energy Efficiency through Design Solutions, and
(iii) Use of Zero or Low emission Fuels.

These pathways need however systematic support of an enabling environment by:

[2] https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/annex/MEPC%2080/Annex%2015.pdf
[3] https://unctad.org/publication/review-maritime-transport-2023

(a) Policy-driven Actions, (b) Synergistic Collaboration amongst multiple Stakeholders (c) Research & Development and Innovation, (d) People-centric Capacity Building & Training and (e) Investment in Maritime Decarbonization & Innovative Finance.

Figure 1: Maritime Decarbonization Pathway & Supporting Ecosystem



While the Policy-driven Actions are at the core of a supporting ecosystem and globally are lead by IMO, the focus of the past Innovation Forums has been on the other components of the enabling environment, as shown in Figure 1 above, which are necessary for the efficient implementation of the policies. As the previous Forums have focused on different elements of this enabling environment (with 2022 Innovation Forum dedicated to Research & Development), the 2024 IMO-UNEP-Norway Innovation Forum, based on observations and lessons learnt from the previous Forums, put its focus onto showcasing some best practices, developments in relation to:

- **Synergistic Collaboration** among multiple stakeholders showcasing both **National Collaboration** between energy & maritime strategies, as well as **Regional** & **International** level collaboration models & approaches;
- Addressing **Capacity Building** related to the transition, with special emphasis on **seafarers'** needs;
- Highlighting importance of **Innovative Finance** and **Investments** in maritime decarbonization

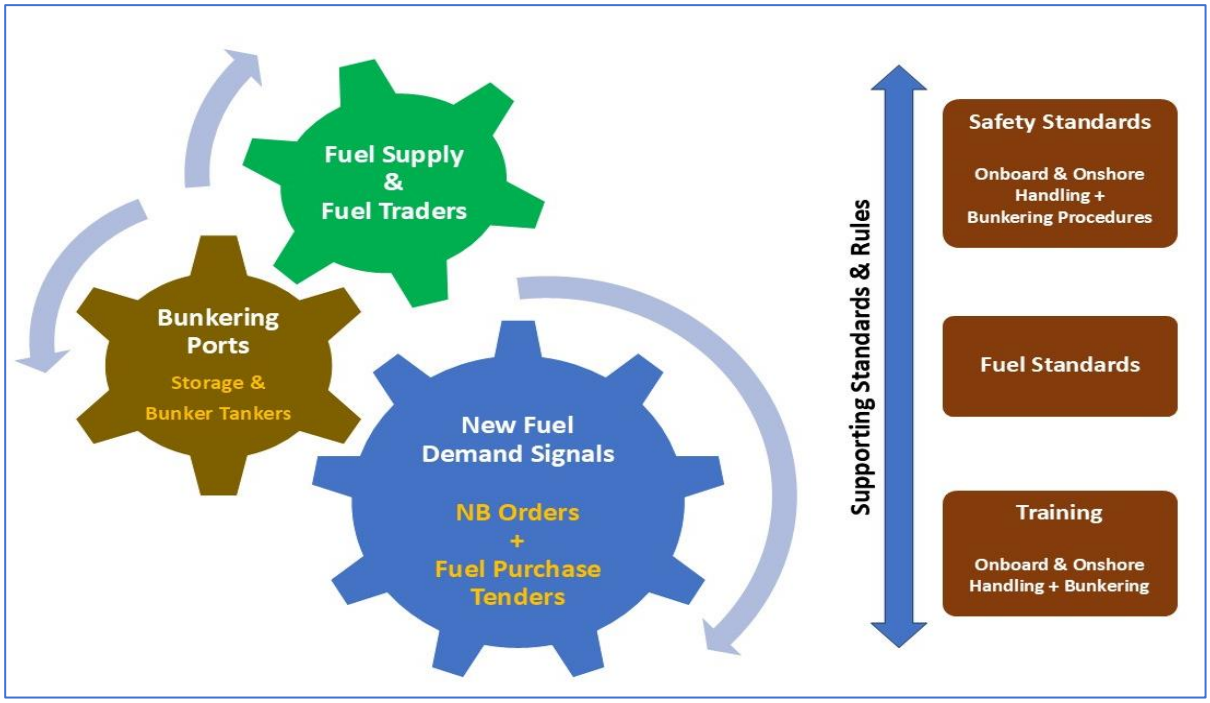
Chapter III: Synergistic Collaboration: on National and International level Between Various Stakeholders to Advance Maritime Decarbonization

1. Introduction

While the energy efficiency steps are mostly within the control of the maritime industry, i.e. the shipowners, ship managers, shipyards as well as the ship operators (while many of these also require investment and cooperation with financial community), the success of the uptake of new fuels requires a **multi-stakeholder collaboration** approach **within and outside** the maritime industry. For example:

(a) Bunkering ports need to develop their infrastructure in terms of storage & bunker tankers,
(b) E-fuels need to be available, i.e. adequate supply for the maritime industry at a cost-effective price needs to be secured and an active market of fuel traders needs to exist,
(c) Supporting rules, standards and training are needed for it to work in a holistic manner.

Figure 2: Multi-Stakeholder Collaboration Approach for uptake of New Maritime Fuels



2. International Cooperation Models: global support to innovation in maritime decarbonization through collaboration

The previous Innovation Forums have highlighted the need of closer collaboration between the energy & maritime sector, ensuring that maritime can serve but also benefit from the global energy transition.

The world's energy sector is continuing to make a significant progress towards a cleaner energy transition. More than 40% of world's electricity came from zero-carbon sources in 2023[4] .

4 https://about.bnef.com/energy-transition-investment/#toc-report

Renewable energy sources like wind and solar made up 17% of total electricity generation, and hydroelectric and nuclear power contributed 24%. Fossil fuels including coal and natural gas produced 57% of global electricity last year. Solar and wind represented more than 90% of global energy capacity additions last year, a step up from 2022. Global wind capacity also crossed the one-terawatt threshold.

In addition, IRENA as the intergovernmental organisation supporting countries in their transition to a sustainable energy future has been analysing specifically the needs of maritime decarbonization and it published a report "A Pathway to Decarbonise the Shipping Sector by 2050", exploring the options and actions needed to progress towards a decarbonised maritime shipping sector by 2050 identifying a realistic pathway to reach the 1.5°C climate goal.[5] The following centres, hubs, coalitions have all been aiming at supporting through collaboration between key stakeholders, with focusing very much also on the maritime-energy axis, enabling maritime decarbonisation and therefore showcased here as international examples of innovation and technology cooperation models for sustainable maritime development.

Furthermore, IMO launched a dedicated website (https://futurefuels.imo.org/) providing access to recent information on zero and near-zero GHG emission marine fuels and technologies (availability, price, technology developments, etc.).

Various other, both governments, industry or public-private collaborations exist extra which aim to support decarbonization of the maritime industry, focusing on specific aspects of the transition, including through establishment of green corridors, as laid out in Annex I to this document.

3. National Cooperation Models: role of Energy Strategies & Transition Programs, National Action Plans and other strategies and their coherence for maritime decarbonization

National Action Plans (NAP) may facilitate the implementation of IMO instruments in the national context and support the achievement of international commitments through complementary national action in relation to shipping decarbonization, in line with the MEPC resolution encouraging Member States to develop and submit voluntary National Action Plans to address GHG emissions from ships (Resolution MEPC.367(79)). Submitted NAPs are available on the IMO website. [6]

The IMO GreenVoyage2050 Programme has published a Guide on the development of National Action Plans (NAPs) to address GHG emissions from ships. The guide provides information on the crucial planning, development and implementation phases involved in the creation of a NAP. With a step-by-step approach, the guide invites policymakers to consider key questions for developing appropriate actions to address maritime GHG emissions, with additional recommendations for SIDS.

5 https://www.irena.org/Publications/2021/Oct/A-Pathway-to-Decarbonise-the-Shipping-Sector-by-2050
6 https://www.imo.org/en/ourwork/environment/pages/relevant-national-action-plans-and-strategies.aspx

As part of its planned activities, GreenVoyage2050 is supporting several countries to develop their own NAPs, unique to their own national maritime contexts and where relevant, exploring the production potential of alternative fuels which could be deployed in the maritime sector. This support includes raising awareness and securing buy in for NAP development, facilitation of stakeholders and technical guidance and support. GreenVoyage2050 will release open calls on an annual basis for Member States to express interest in receiving technical assistance to develop NAPs.

Some countries are considering shipping decarbonization as an opportunity to spur new growth areas, create job opportunities and to address current vulnerabilities in energy security. Three examples from different regions, i.e. viz. **Chile, Morocco, India** have been all taking this approach during their NAP development, to varying degrees.

Chile is trying to use its rich renewable resources to increase the country's electrification drive, and to decarbonize its hard-to-abate domestic mining sector as well as to use green shipping corridor to export its mined commodities, and to export green hydrogen or its derivates. **Morocco** is reducing dependence on imported fossil fuels through renewables and aiming to produce e-fuels (ammonia) via P-to-X route for use in fertilizer as well as in shipping industry. India is planning to take advantage of low-cost renewable energy to electrify the domestic shipping including inland water transport, and in the process, providing support to its domestic shipyards. **India** is also trying to leverage its low-cost hydrogen to develop e-fuels for use in fertilizer and shipping industry and to develop bunkering hubs.

Opportunities may also arise due to the inherent molecular structure of the new fuels. Due to low volumetric energy density of e-methanol and e-ammonia, container lines, which are extremely sensitive to capacity utilisation, may opt for more frequent bunkering as opposed to carrying more fuel which would lead to sacrificing TEU loadings and thus lower utilization. SIMOPS or simultaneous operation of bunkering activity concurrent with cargo handling is a common practice for container lines. Hence, this creates an opportunity for additional bunkering hubs to emerge along the main container routes, e.g. those in India.

Launching Expression of Interests (EOIs) and Request for Proposals (RFPs) to gauge the market response of announced policies is a good practice. There are examples of countries that are routinely doing that, for diverse areas ranging from investments in ammonia power plant cum bunkering project, methanol & ammonia supply proposals to green financing & insurance offers for prospective new-building of e-harbour crafts. The developing countries, including LDCs and SIDS may adopt this best practice of launching EOIs and RFPs to test the private sector's interest in the government's policies. They may consider engaging independent parties to administer the process.

National best practices examples further analyses can be found in Annex II to this document, under "Case Studies on National Level Coherence established between Maritime & Energy Transition Needs".

Chapter IV: People-centric Capacity Building & Training: Special Emphasis on Seafarers

The transition in maritime towards a decarbonized sector has already begun and will continue, but this must be done in an **inclusive** way.

1. IMO's global capacity building support for the developing countries

IMO, on the global level is assisting developing countries, in particular SIDS and LDCs, in addressing GHG emissions from international shipping through its Technical Cooperation (TC) programme, including a dedicated TC fund and a wide portfolio of projects dedicated to climate action, implemented by the newly re-structured Technical Cooperation and Implementation Division (TCID) of the Secretariat.

The **GreenVoyage2050 Programme** has officially entered its Phase II (2024-2030) with over $21 million in funding from the governments of Denmark, Finland, France, Germany, the Netherlands, and Norway. The Programme accelerated its work in supporting partnering countries (Belize, Cook Islands, Kenya, and the Solomon Islands) in developing National Action Plans (NAPs) for Green Shipping, published a new training course on Onshore Power Supply, developed a Routes-based action Plans Toolkit to support accelerating the uptake of clean marine fuels, and is intensifying its technical assistance towards the development of pilot project feasibility studies. Through its Low Carbon Global Industry Alliance (Low Carbon GIA), the Programme continued to develop resources, including a simplified glossary that supports the industry to gain a better understanding of the terminologies and phraseologies used in life cycle assessments (LCA), as well as a video series on IMO's EEXI and CII frameworks.

IMO CARES (Coordinated Actions to Reduce Emissions from Shipping) project (approximately $1.6 million, 2023–2024), with funding from Saudi Arabia, focused on technology solutions for domestic shipping (under 5,000 GT) and ports. The project delivered a global technology competition (Global Challenge) involving 23 technology providers and promoted the accelerated adoption of green maritime technologies in developing countries, especially SIDS and LDCs. The project funding supported the development of in-depth technical proposals by the winning technologies and host countries, which included Waste to Energy in Mauritius, Vertical Wind Turbine in St. Kitts and Nevis, and Port call optimisation applications in Namibia and Trinidad and Tobago. The MTCCs in Africa and the Caribbean region provided guidance during this process. A comprehensive technology report on the decarbonization of domestic shipping in developing regions was developed under this project, which identifies the green technologies in use, their efficacy, and their future potential.

The **Global Maritime Technologies Cooperation Centres (MTCC) Network (GMN)** project (approximately €10 million, 2024-2027), with the support of the EU, entered Phase II, which will focus on six technology demonstration pilot projects aimed at reducing GHG emissions from ports and domestic vessels (under 5,000 GT) in Africa (Mauritius and Namibia), the Caribbean (St Kitts and Nevis and Trinidad and Tobago), and the Pacific region (to be decided).

The **Sustainable Maritime Transport Training Programme (GHG-SMART),** funded by the Republic of Korea ($4.5 million, 2022 to 2026), supports small islands developing states (SIDS)

and least developed countries (LDCs) with the implementation of the IMO GHG Strategy, through capacity building in maritime decarbonization, with annual training cycles comprised of theoretical and practical sessions and study visits complemented with post-training scholarships at the World Maritime University. Since 2022 professionals from 20 SIDS and 18 LDCs have been trained on relevant aspects of maritime decarbonization including regulatory frameworks, ship and port technologies and operations, policy and finance.

The IMO-UNEP-Norway Innovation Forum (~$0.65 million, funded by Norway) is an annual global joint initiative between the International Maritime Organization (IMO), the United Nations Environment Programme (UNEP) and the Government of Norway, bringing together a broad spectrum of stakeholders to champion innovation and accelerate the transition of the maritime sector towards a zero- and low emission future, with a focus on the needs of developing countries, SIDS and LDCs.

The **SMART-C GHG Project** (2023-2027, $ 4 million, supported by Republic of Korea) is providing tailor-made support to Viet Nam and The Philippines for their development of National Action Plans and implementation of the 2023 IMO GHG Strategy.

2. Seafarers' Training:

Efforts have been undertaken by IMO and other key stakeholders to support seafarers training needs.

The '**Maritime Just Transition Task Force**' is spearheading an unprecedented initiative, which is paving the way for training of seafarers in new fuels as the maritime industry is taking steps to decarbonise.
Set up during COP 26 in Glasgow in 2021, by the International Chamber of Shipping (ICS), the International Transport Workers' Federation (ITF), the United Nations Global Compact (UNGC), the International Labour Organization (ILO) and the International Maritime Organization (IMO), to ensure that shipping's response to the climate emergency puts seafarers at the heart of the solution, supported by globally established Just Transition principles.

Further, a large number of organisations are involved through a global industry peer learning group, which will provide important knowledge-sharing. The Project is co-funded by IMO through its technical cooperation funding, including the IMO GHG TC Trust Fund, and by the Lloyd's Register Foundation.

Once developed, the Baseline Training Framework for Seafarers in Decarbonization will be first tested out in Asia through a programme led by WMU, with support from the IMO Maritime Technology Cooperation Centre (MTCC) Asia and other partners. The Project, through its **train-the-trainer courses**, shall train several instructors, taking into consideration a gender-balanced approach. The aim is to then expand testing of the package globally with all the established MTCCs and other appropriate organizations. The packages will also be available to IMO Member States, for potential use by maritime education and training (MET) institutes to develop their programmes, as appropriate.

The Maritime Just Transition Task Force has identified that up to **800,000 seafarers** may require additional training by the mid-2030s to handle zero carbon fuels. The timeline of MJT Task Force is to develop **the training materials by mid-2025**.

National experience example (Singapore): Maritime Energy Training Facility

As the number of ships operating on zero or near-zero emission fuels grows, there is need for more maritime personnel and seafarers to be trained and equipped to operate these ships safely and efficiently. To address the current competencies gap, the Maritime and Port Authority of Singapore (MPA) will establish Maritime Energy Training Facility (METF), in partnership with industry players. See Appendix 5 for the list of partners.

METF will be set up as a decentralised network of training facilities. It will include amongst others, (a) Dual-fuel marine engine simulator, for training on the safe handling, bunkering, and management of alternative fuels, such as methanol and ammonia, (b) Integrated engine room and bridge simulators, (c) Emergency Response Training and (d) an AR (augmented reality)-enabled scenario-based Maritime Safety Training. Around **10,000** seafarers and other maritime personnel are expected to be trained at METF from now to the 2030s, as the facilities are progressively developed by 2026.

For ammonia bunkering, a guidebook detailing custody transfer requirements, bunkering procedures and safety precautions, as well as a competency framework to train personnel, was developed by GCMD. The competency framework has been developed into a curriculum in partnership with the Singapore Maritime Academy. The first training course that includes handling of ammonia under the International Code of Safety for Ships Using Gases or Other Low-flashpoint Fuels (IGF Code) took place in March & June 2023.

Chapter V: Investments in Maritime Decarbonization & Innovative Finance

The 2023 IMO GHG Strategy recognizes the importance of creating opportunities for developing countries, including LDCs and SIDS, to take part in the value chain of the production and distribution of zero and near-zero GHG emission technologies, fuels and/or energy sources for international shipping.

Maritime decarbonization offers an opportunity for developing countries, such as those endowed with renewable & other related resources (e.g. Lithium), to become the producers of zero and near-zero GHG emissions technologies and fuels, but at the same time this transition will need significant investments globally, with the majority linked to land-based infrastructure, with majority of investments to support alternative fuel development for shipping. UNCTAD reports that an additional $8 billion to $28 billion will be required annually to decarbonize ships by 2050, and even more substantial investments, ranging from $28 billion to $90 billion annually, will be needed to develop infrastructure for 100% carbon-neutral fuels by 2050.

The IMO-EBRD-World Bank FINSMART Roundtables [7] have been aiming to address main investment opportunities and challenges for maritime decarbonization, with a focus on developing countries, especially LDCs and SIDS needs and has recognized the important role of Multilateral Development Banks (MDBs) who, both through public and private investing, play a crucial role in developing countries where conventional private investors are often reluctant to invest.

As a share of all investments of MDBs, estimate is that shipping and port development play a very minor role, generally making up less than 2%. Shipping generally doesn't fall under the public sector, which is why public lending is focused on port finance, while private sector investments are more minimal.

Current MDB ship and port decarbonization financing investments are rather limited as such investments have just started to take off in the last decade. In port development projects, decarbonization often is not the main objective but is rather incorporated as part of the overall infrastructure development (e.g. EBRD Tersan Expansion or AfDB Banjul Port Expansion).

However, this inclusion is becoming more and more common, especially since a common MDB declaration to align with the Paris Agreement and they may also address creating an environment where decarbonization and alternative fuel projects are bankable. For example, Inter-American Development Bank (IADB) published a report on **Opportunities for Electric Ferries in Latin America**.[8] A similar study was published on Hydrogen Opportunities.[9]

This is all against backdrop of energy finance being one of the biggest portfolios in MDBs, while alternative fuel investments are also intensifying. In connection to alternative fuels for maritime, insecurity on maturing technologies and capacity is slowing this process. Alternative fuel investments however, both in development and production, typically span across multiple sectors and only in parts may benefit the decarbonization of international shipping e.g. World Bank's financing of India Low Carbon Energy.[10]

Some MDBs highlighted success of ecosystem approach investment, where alternative fuel development is to serve transport, both land and sea-based, with a central role for the ports (example hydrogen project EIB financed offshore wind, to support greater hydrogen transport project). Typically, an ecosystem approach embodies aggregation of demand across several sectors improving the business case, and thus bankability of the projects.

As the above showcases, while there are some positive steps, current investment in developing countries is very low from MDBs related to maritime and specially related to maritime decarbonization and to supporting implementation of the IMO 2023 GHG Strategy. Reasons for this may be related to:

(a) not visibly showcasing maritime as key for development and climate agendas, both nationally and internationally;

[7] https://www.imo.org/en/OurWork/PartnershipsProjects/Pages/FINSMART-Roundtable.aspx
[8] https://publications.iadb.org/en/opportunities-electric-ferries-latin-america
[9] https://blogs.iadb.org/energia/en/unlocking-green-and-just-hydrogen-in-latin-america-and-the-caribbean/
[10] https://www.worldbank.org/en/news/press-release/2024/06/28/world-bank-approves-additional-1-5-billion-in-financing-to-support-india-s-low-carbon-transition

(b) Lack of information and knowledge of maritime authorities in developing countries of MDB financing mechanisms, funding procedures and crucial elements of developing bankable project proposals;
(c) Lack of coordination between energy, finance and maritime authorities in relation to overall energy, alternative fuel and maritime development ambitions of the countries;
(d) Projects that could enable a shift to alternative fuels in the shipping sector aren't ready yet and first require technical assistance to make them bankable for MDBs;
(e) Alternative fuel development projects may be at a financial volume the MDBs cannot cover alone with the current risk mitigation instruments.

There is a strong interest from FINSMART participant MDBs however to support further maritime decarbonization via financing bankable project proposals in developing countries and the above challenges could be overcome by:

(i) Coordinated communication efforts of the maritime community, showcasing importance of the industry overall and specifically its decarbonization needs as part of developing and climate agendas both on national and international level;
(ii) Strengthen knowledge, information and capacities of maritime authorities in developing countries on potential financing options from MDBs and on how to develop a feasibility study / bankable project proposal (current document also aims towards this information and knowledge sharing as first step);
(iii) Strengthen coordination between authorities, bodies, key stakeholders who all need to take part to ensure successful implementation of the IMO 2023 GHG Strategy through coordinated investment with an ecosystem approach, i.e. special cooperation between energy, maritime and finance government bodies and private sector as well;
(iv) Undertake further alternative fuels/maritime decarbonisation specific pilot project, which can support feasibility and lay down bankability of future major investments;
(v) Recognize need for additional, innovative funding mechanisms, noting conflicting priorities for existing MDB funding may put at risk fulfilling all investment needs.

The IMO 2023 GHG Strategy provides an important direction to investors and that, together with the actions described above can trigger investment in alternative fuel related opportunities for maritime in developing countries. The role of MDBs and other financial players is crucial and FINSMART and its MDB members are ready to continue supporting through informative Roundtables with an aim to support accelerating financial flows – particularly in developing countries, for decarbonization of maritime sector, in line with country priorities and the goals of the 2023 IMO GHG Strategy.

Chapter VI: Questions for Further Consideration

In the previous sections we have discussed the selected components of an enabling environment for a successful transition to maritime decarbonization, viz,

- **Synergistic Collaboration** among multiple stakeholders, showcasing both **National Collaboration** work between energy and maritime strategies, as well as **Regional, International** level collaboration models & approaches;
- Addressing **Capacity Building** needs related to the transition, with special emphasis on **seafarers'** needs; and
- Highlighting importance of **Innovative Finance and Investments** in maritime decarbonization (and its enabling environment)

In order to stimulate the discussions further, here are some suggested questions on the respective topics to both Innovation Forum Panel members and participants:

On Innovation & Technology Cooperation Models: National, Regional & Global Best Practices

- What is it at the core of their respective approaches that supports technology development & deployment and innovation in developing countries?
- How do they support maritime decarbonization and their links to the energy transition?

On National Approaches to implementation of the IMO 2023 GHG Strategy

- How do your national approaches to implementation of the IMO 2023 GHG Strategy integrate with innovation needs?
- How do these strategies link to other national plans addressing the energy transition and overall development needs?
- How do you envision the establishment & operationalisation of closer links between maritime decarbonization and the energy transition?

Global Support & Innovation in maritime decarbonization

- How do you see your work contributing to maritime decarbonization on a global level?
- In which ways could your work be a model to support maritime decarbonization in developing countries?
- How do you integrate innovation in your work?

Maritime Decarbonization: A "Just" Transition for Seafarers

- What is Just Transition? What are the challenges & opportunities related to it?
- What are the challenges faced and opportunities presented for seafarers in relation to maritime decarbonization?
- What is the role of various stakeholders in addressing these challenges?

Enabling Innovation in Maritime Decarbonization through Finance

- What type of innovative instruments exist that support maritime decarbonization?
- How have you integrated maritime decarbonization goals into your investments?
- Which positive trends do you see in relation to investment that supports sustainable maritime transition in developing countries?
- What data are available on investment supporting maritime decarbonization in developing countries?

ANNEX I:

Table (1) International Cooperation Models: Examples of initiatives supporting maritime decarbonization through stakeholders' collaboration

Govt-led Initiatives	Knowledge Centres & Not-for-Profit Orgs	Private Sector Initiatives
Clean Energy Marine Hubs: -The **Clean Energy Marine Hubs** (CEM-Hubs), led by Clean Energy Ministerial (a high-level global platform of governments to advance clean energy tech) + International Chamber of Shipping, + International Association of Ports & Harbors -Aims to organize synergistic collaborations **between fuel producers, buyers, storage players, shipping companies to provide new fuels to all**.	**Global Industry Alliance**: IMO's public-private partnership, set up under GreenVoyage2050. To address **common barriers to the uptake of energy efficiency technologies, operational best practices and alternative low and zero carbon fuels**	**First Movers Coalition**: through this platform over 95 members send **world's largest clean demand signal for emerging climate technologies** in 6 sectors aluminium, cement & concrete, steel, aviation, **shipping**, & trucking Commitment of members in shipping: -To **use zero-emission fuels** in new & retrofitted zero emission vessels by '30
	Global Maritime Forum (HQ in Copenhagen): is an independent not-for-profit organisation that focuses on decarbonising the maritime industry and making life at sea more inclusive & appealing to people of all backgrounds. It has **60 partners: shipping & ship management companies**, **cargo owners, ports & canals** **Getting to Zero Coalition**: Under the Global Maritime Forum umbrella), a powerful alliance of more than 200 organisations (including over 180 private companies) within the maritime, energy, infrastructure, and finance sectors. The Coalition is committed to **getting commercially viable zero-emission vessels powered by zero-emission fuels into operation by 2030** along with the **associated scalable infrastructure**	
	Global Centre for Maritime Decarbonisation: is a non-profit org. that supports maritime sector's decarbonisation through **pilots & trials**. Founded by **6 industry partners**, GCMD receives funding from MPA for research & development projects. Initiatives: (i) **Ammonia** as a marine fuel, (ii) assuring the quality, quantity + emissions abatement of **Biofuel,** (iii)	

	Onboard Carbon Capture & Storage, and (iv) scaling adoption of **energy efficiency** technologies	-Carriers set a target that at least **5%** of their deep-sea shipping will be powered by zero-emission fuels by '30, -Cargo owners have also set a target that at least **10% of the volume** of their goods shipped internationally will be on ships using zero-emission fuels by 2030, on the way to 100% by 2040. **MO**L, the **Shipping Sector Champion**, is leading the discussions on promoting zero-emission fuels
Mission Innovation: **A** global forum for governments, committed to pioneering clean energy solution through domestic innovation action + international cooperation. Catalysing actions through public-private Missions that set ambitious and inspirational innovation goals. **Zero Emission Shipping** is one such Mission whose goals are: -**600 large ships in international shipping to be running on well-wake zero-emission fuel by 2030** -Enable the **production 16 M ton of heavy fuel oil equivalent well-to-wake zero-emission fuels by 2030** -**20 key ports covering at least 3 continents offering well-to-wake zero-emission bunkering by 2030**	**International Renewable Energy Agency (IRENA):** an inter-governmental organisation supporting countries in their energy transition. Published: **A Pathway to Decarbonise the Shipping Sector by 2050,** for a realistic pathway to reach 1.5°C climate goal	
	Lloyd's Register Maritime Decarbonization Hub: follows an independent, **evidence-based approach**, carrying out **research** into **future fuels**, creating projects with partners, managing pilot programmes and publishing the results openly & transparently. Maintains a **fuel agnostic** position. Using its **Zero Carbon Fuel Monitor**, stakeholders can track the state of readiness of each fuel	
	Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping: a not-for-profit, independent **research & development** centre. Drives new technologies; builds confidence in new concepts and advocates for systemic & **regulatory change**. Headquartered in Copenhagen, has 44 partner organizations and 58 mission ambassadors	

Table (2) Examples of International Collaborations in Green Shipping Corridor Initiatives

Govt-led Initiatives	**Private Sector Initiatives**	**Knowledge Centres**
Clydebank Declaration: At COP 26, 22 countries including Chile, Costa Rica, Fiji, Marshall Islands, Morocco, signed the Declaration => supporting the establishment of at least six green corridors by the middle of this decade	Silk Alliance: A first-mover initiative on green corridors & zero-emissions shipping, with a fleet operating across Indian + Pacific oceans. 18 members: maritime, energy, finance + public sector. Led by Lloyd's Register Maritime Decarbonisation Hub	Frameworks: Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping published "A Framework for Developing Just & Inclusive Green Shipping Corridors Lloyd's Register Maritime Decarbonization Hub prepared "Routes-based Action Plan: A Toolkit" which was unveiled at an IMO-MPA-NextGEN Connect forum
Innovation Challenge (by UK Govt.): Following the Clydebank Declaration, a £1.5 M International Green Corridor Fund was launched, in collaboration with Norway, Denmark + Netherlands. The 5th round of Clean Maritime Demonstration Competition with £1.5 M funding will support feasibility studies, to map out infrastructure required along the routes to enable vessels to access green fuels and power charging systems, as well as look at further regulations required to push towards decarbonisation	Cargo Owners in Bulk Corridors: companies representing major players in the mining sector e.g. BHP, Rio Tinto, Fortescue Metals Group, Anglo-American and Codelco, and even their customers e.g. Tata Steel and Volvo, are taking the lead. Acting as catalyst of progress	
G-to-G Green Corridor Declarations:	Zero Emission Maritime Buyers' Alliance (ZEMBA):	

There are several G-to-G corridors e.g. Australia-New Zealand, LA-Long Beach – Shanghai, Gothenburg – Rotterdam, Singapore-LA-Long Beach, Singapore-Rotterdam, Australia-Singapore. Many of these G-to-G initiatives are focussing on harmonization of standards and facilitation of data exchange	On April 2024, ZEMBA successfully completed its first collective tender under which over a dozen companies have committed to purchase the environmental attributes associated with over 1 billion TEU-miles of zero-emission shipping on a route from Singapore to Rotterdam in 2025-2026. Global container line Hapag-Lloyd won ZEMBA's first tender. Its certified, exclusively waste-based biomethane service aims to provide members with an over 90% emissions reduction (i.e. ~ 82K tons of CO_2e over two years) on a lifecycle basis on their volume committed through the ZEMBA tender. This deal was restricted to 2025-2026, in order to allow the members an opportunity through ZEMBA's second tender to focus on supporting e-fuels & technologies of nonbiological origin, as the first deployment of e-fuels is expected around '27	The US Govt prepared "Green Shipping Corridors Framework"

ANNEX II:

CASE STUDIES ON NATIONAL LEVEL COHERENCE ESTABLISHED BETWEEN MARITIME AND ENERGY TRANSITION NEEDS

ASIA PACIFIC CASE STUDY: INDIA

1. Country Climate Policy & Energy Transition Objectives

Energy use has doubled in the last 20 years and is likely to grow by at least another 25% by 2030. India currently imports over 40% of its primary energy requirements, worth over USD 90 billion every year. India has set its sight to reduce the carbon intensity of the nation's economy by less than 45% (vis-à-vis 2005 level) by 2030, on becoming energy independent by 2047 and on achieving Net Zero by 2070, including through specific strategies as described under.

Renewables

As of Aug 2024, Renewable energy sources, including large hydropower, have a combined installed capacity of ~ 200 GW, representing about 44% of country's installed power capacity. India aims for 500 GW of renewable energy installed capacity by 2030.

Hydrogen

The asymmetries in expected demand and production capabilities for Green Hydrogen, in different countries and regions, are likely to result in international trade of Green Hydrogen and its derivatives like Green Ammonia and Green Methanol. India, with its vast renewable energy resources, has the opportunity to produce Green Hydrogen for the world. The **National Green Hydrogen Mission** (https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2023/01/2023012338.pdf) aims to provide a comprehensive action plan for establishing a Green Hydrogen ecosystem and catalysing a systemic response to the opportunities and challenges of this sunrise sector

Mission will build capabilities to produce at least 5 Million Metric Tonne (MMT) of Green Hydrogen per annum by 2030, with potential to reach 10 MMT per annum with growth of export markets. The Mission also aims to make India a leader in technology and manufacturing of electrolysers and other enabling technologies for Green Hydrogen.

Reliance Industries intends to invest **$10 billion** over the next three years in a 20km^2 green energy complex at Jamnagar. This would be dedicated to electrolysis to produce **green hydrogen** and **fuel cells** for converting hydrogen into mobile and stationary power. Another project is ongoing at Indian Oil's Gujarat refinery, wherein the focus is on creation of **blue hydrogen** with carbon capture technology.

Biofuels

India's Ministry of Petroleum and Natural Gas published its "National Policy on Biofuels" in 2018 (https://mopng.gov.in/files/uploads/NATIONAL_POLICY_ON_BIOFUELS-2018.pdf), and in June 2022, amended it further (https://mopng.gov.in/files/article/articlefiles/Notification-15-06-2022-Amendments-in-NPB-2018.pdf). The policy's objective is to reduce the import of petroleum products by fostering domestic biofuel production, improving availability of biofuels in the market thereby increasing its blending percentage.

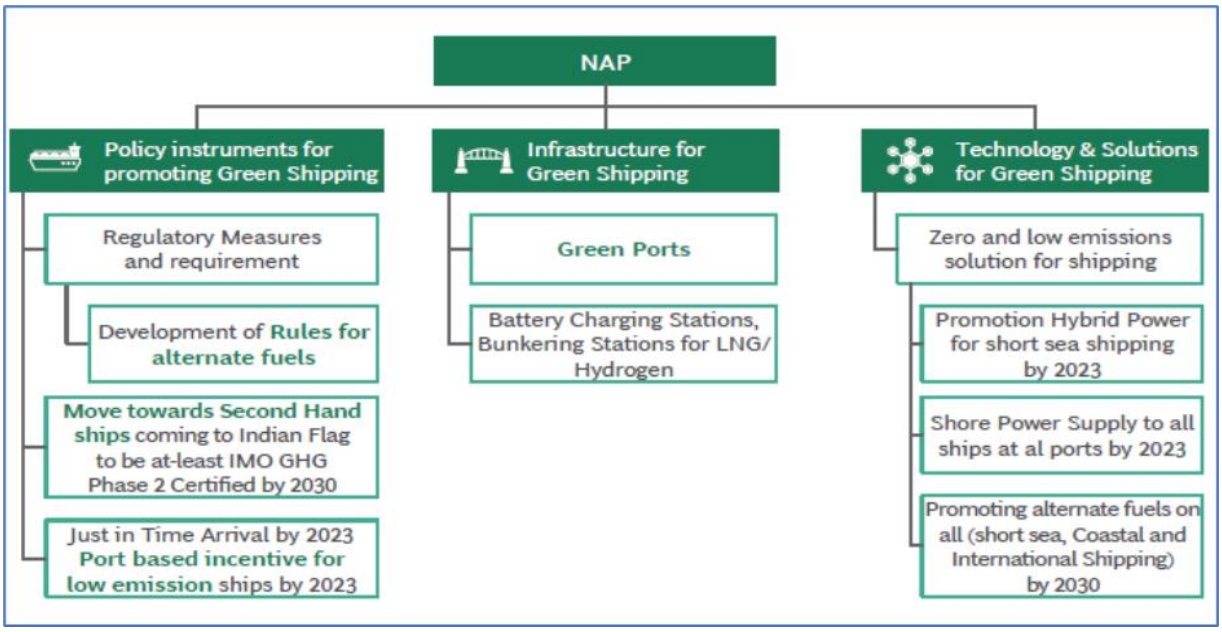
Currently, the ethanol blending percentage in petrol is around **2.0%** and biodiesel blending percentage in diesel is less than 0.1%. The policy sets a target of **5% biodiesel blending** in diesel by 2030. After the Amendment, through which additional feedstocks for biofuels are made available, the deadline to reach the blending target of **20% bioethanol in petrol**, is advanced from 2030 to 2025-26.

2. **National Action Plan on Maritime Decarbonization ("NAP")**

The document titled **Maritime India Vision (MIV) 2030**, in its Chapter 9 (as available on IMO web site; https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Air%20pollution/Maritime%20India%20vision%202030.pdf), addresses the country's Maritime Decarbonization Plan. Building upon the MIV 2030, the **Maritime Amrit Kaal Vision 2047** was launched in October'23, (https://shipmin.gov.in/sites/default/files/Maritime%20Amrit%20Kaal%20Vision%202047%20%28MAKV%202047%29_compressed_0.pdf) by the Ministry of Ports, Shipping & Waterways (MoPSW), Government of India, presenting a **holistic transformation plan** of the maritime sector as well as a fillip to the **blue economy.** Interestingly, the Prime Minister of India, in his message at the launch said: "It also outlines a roadmap for **sustainable development** related to oceans, rivers and coastal regions, which also focuses on **equity, inclusivity and innovation**", a recurring theme of this Innovation Forum.
This vision includes ambitious targets such as sourcing **60%** of each major port's power demand from **renewable energy** and achieving a **30% reduction** in **carbon emissions per ton of cargo** by 2030 and 70 % reduction by the year 2047.

India's NAP has three main focus areas, viz. (i) Green Ports, (ii) Green Harbor Crafts and (iii) Future Marine Fuels, supported by technical & other solutions and policy instruments. See **Figure 3** below.

Figure 3: India's National Action Plan on Maritime Decarbonization



In support of the MIV, the MoPSW announced, in May 2023, the **Green Port Guidelines** (https://shipmin.gov.in/sites/default/files/Harit%20Sagar%20-%20Green%20Port%20Guidelines%20.pdf). The goal is to develop **carbon neutral ports** in India in the next 25 years. Following are the key elements:

Electrification of Port Equipment & Vehicles:

(i) Ports shall target more than 50 % electrification (of vehicles and equipment) by the Year 2030 which is to be further increased to more than 90 % by the year 2047.
(ii) Ports should target retro-fitment / conversion of diesel-powered equipment, cranes, forklift, pay loader, vehicles etc. to be electrically powered in a phased manner by making suitable plans.
(iii) All future procurements of Port vehicles and cargo handling & other equipment shall preferably be electrically driven / electrically powered or should be compatible with low carbon greener fuels viz., CNG, Methanol, Ethanol, Ammonia, Hydrogen Fuel Cell etc.

Renewable Energy:

(i) The current consumption of renewable energy at the Indian Major Ports is less than 10% of the total power demand. Accelerate adoption of renewable source of energy through usage of PVs on rooftop installation and mooring and dolphin structures. Share of **renewable energy** at Ports should **exceed 60 %** by the Year **2030** and **90 %** by year **2047**.
(ii) Selected Port(s) shall upgrade / augment their Infrastructure to support Offshore Wind Energy projects by facilitating and providing services to the industry for assembly, staging, fabrication, storage, and loading of **Wind Turbine Generator** (WTG) components for offshore installation. **Tuticorin port** has been selected for a pilot project on offshore wind

farm, to be executed by **Ministry of Power**. This is an example of collaboration between different government agencies.

Charging Infrastructure & Shore to Ship Power Supply:

(i) Ports shall establish adequate number of EV charging stations by the year 2025.

(ii) All Ports shall develop the infrastructure to provide "Shore to Ship" power in a phased manner:

- 1st Phase: to Harbor Crafts by 2023
- 2nd Phase: to Coast Guard/Navy and small coastal vessels by 2024
- 3rd Phase: to EXIM vessels by 2025

Vishakhapatnam Port is giving shore to ship power for tugs. Kamarajar Port (formerly known as Ennore Port) also has shore power supply for tugs and pilot boats. Chennai Port gives shore power to vessels including coast guard vessel. Cochin Port has infrastructure for shore power at 11 berths. Mormugao Port Authority supplies shore power to cruise, tugs, and Indian coast guard vessel. Shore power supply operations for coast guard and port vessels has started at Mumbai Port. JNPT is currently supplying shore power to tugs.

(iii) Distribution License: As per Electricity Act 2003, commercial power transmission, distribution and trading is not permitted by any entity other than Distribution Companies. MoPSW is to align with Ministry of Power so as to allow ports for commercial power distribution. This is another example of collaboration needed between different government agencies.

Biofuels:

Port Authorities to explore:

(i) PPP model for conversion of trucks and

(ii) for development and operation & maintenance of Bio-diesel retail outlets at ports.

Harbor Crafts & Inland Water Transport (IWT)

(i) Ports shall make efforts to **retrofit Harbor Crafts,** enabling them to run on cleaner and greener fuel viz., Green Ammonia, Green Hydrogen (through Fuel Cell), Green Methanol, in a phased manner.

(ii) The Ministry of Ports, Shipping & Waterways announced **Green Tug Transition Program** (GTTP) (https://pib.gov.in/PressReleasePage.aspx?PRID=2045946#:~:text=The%20program%20is%20expected%20to%20involve%20an,first%20set%20of%20tugs%20will%20be%20battery%2D) in Aug 2024. Phase 1 of the GTTP will begin on October 1, 2024, and continue until December 31, 2027. During this phase, four Major Ports viz. Nhava Seva, Kandla, Paradip and Tuticorin will procure or charter at **least two green tugs each**, based on standardized designs and specifications. The first set of tugs will be **battery-electric**, with provisions for adopting other green technologies such as hybrid, methanol, and green hydrogen as the industry evolves.

(iii) India aims to convert its entire coastal and inland waterways shipping to renewable energy in the next five years (https://www.reuters.com/world/india/india-aims-green-shipping-inland-waterways-five-years-officials-2024-03-07/).

Future Marine Fuels

(i) Ports shall establish at least one **LNG bunkering** station by the Year 2030

(ii) **Green Ammonia bunkers and refuelling facilities** shall be established at least **at one port by 2025** and at all Major Ports by **2035**

(iii) Develop key Indian Ports as International **Hubs for Hydrogen** production, application and trade. Potential locations for such Hubs would be regions having clusters of **refineries or fertilizer** production plants in close vicinity. Kandla, JNPA, New Mangalore, Cochin, Visakhapatnam Port as well as Andaman and Nicobar Islands can be potential locations for such Hydrogen Hubs.

Additional Incentives, Other Policy Instruments & Supporting Enablers

(i) Petroleum & Natural Gas Regulatory Board allows any eligible entity to set up **LNG** station anywhere in India. Common guidelines launched to set up dealer operated-**CNG** stations in India

(ii) Indian port authorities are encouraged to offer **discounts** on port dues & cargo handling charges or other form of incentives, e.g. **priority berthing**, to promote operations of clean fuelled vessels.

(iii) **Truck** operators, **stevedores**, agents, exporters & importers at Port who are running their **equipment** and **vehicles** with green fuel or electric for all its fleet may be identified and recognized through green certification and may be suitably incentivized.

(iv) Ports shall devise suitable mechanisms to incentivize the existing **PPP concessionaires** to adopt greener and carbon neutral designs and procedures in line with the spirit of these guidelines.

(v) Continuation, by another 10 years of the **financial assistance policy** for **ship building & retrofitting** of green vessels with ~**30-40% assistance**

(vi) Extend **production linked incentive** (~4%-6%) on incremental sales to attract large investments and to boost domestic manufacturing of marine **Hydrogen fuel cells** and **Ammonia marine engines**

(vii) Enable Indian Shipyards to develop green, home-grown technology for Hydrogen / Ammonia fuelled vessels & low-cost green technologies. **Export home-grown green technology to the world**.

3. The Process of Development of the NAP and the Maritime India Vision

The NAP and the Vision have been prepared through more than 150 consultations with public and private sector stakeholders, comprising of Government Ministries & Departments, Major Port Trusts, State Maritime Boards & other Departments, as well as the representatives from the shipping industry, financial institutions and academia. In developing the NAP & the Vision, the principles followed are:

(a) Assessment of the current landscape for **identification of gaps** and finding **actionable points** to fill in the gaps for achieving the respective targets
(b) Analysis of international **best practices** across **infrastructure**, **capacity building**, **institutional framework** and **regulatory environment** for developing the actionable points
(c) Developing framework for **improving innovation and financing** in the maritime sector
(d) Driving the agenda for promoting **self-reliance** and **sustainability** in the maritime sector
(e) Defining the **timeline** for the implementation of the actionable points.

More than 50 international benchmarks were analysed. The NAP and the Vision have identified more than 300 actionable points.

4. Author's Analysis of Key Learnings from India's NAP & Its Development Process

Following are some of the key learnings from India's NAP and its NAP development process:

(a) Stakeholder Engagements: the development process involved multiple stakeholder engagements
(b) Innovation & Financing: innovation & financing enabling framework was incorporated in the NAP
(c) Best Practices Referencing: it studied the best practices across multiple areas including capacity building in developing its NAP
(d) Strong Interplay with Nation's Energy Transition Strategy: there is a strong interplay between the nation's energy transition program and its NAP. For example, leveraging its energy transition program (which has renewables and biofuels as important components), the use of renewables and bio fuel feature prominently in the country's Green Ports initiative. The increased use of LNG for the country's energy needs has led to a maritime ambition of setting up of LNG bunkering terminals. The aim of developing a hydrogen economy has led to a maritime aspiration of producing & supplying e-fuels for shipping as well as setting up of bunkering terminal for e-fuels.
(e) Maritime Decarbonization to spur Growth: the country is seeing maritime decarbonization as an opportunity to spur growth and create jobs. For example, leveraging on its own ambition of decarbonizing its inland water transport, it sees an opportunity for Indian shipyards to produce electric ferries for the world and is crafting incentive scheme to help the shipbuilding industry. It aspires to become manufacturing centre for hydrogen fuel cells and ammonia marine engines and is crafting production linked incentives to support such aspirations.

AFRICA CASE STUDY: MOROCCO

1. Country Climate Policy & Energy Transition Objectives:

Energy use in Morocco is growing @ 5% per annum, since 2004. Morocco plans to **decrease energy consumption** by **15 %** from 2016 levels by 2030 through improving **energy efficiency** by **20%**. Currently, Morocco is heavily dependent on imported hydrocarbons, and **imports** approximately **90 %** of its energy needs Morocco intends to improve its security of energy supply by reducing dependence on energy imports.

In 2022, 62% of its electricity production came from hydrocarbons (37.25% coal, 17.72% natural gas, 7.03% fuel oil), while the balance **38%** is from **renewables** (16.7% hydroelectricity, 13.48% wind & 7.82% solar). In its 2021 Second NDC report, Morocco aims to **reduce** its **GHG emissions** by **45.5 %** (https://carnegieendowment.org/research/2024/05/morocco-oman-energy-transition-oil-exporting-renewable?lang=en) by 2030, compared to the BAU scenario, the equivalent of 77.5 MtCO2eq.

Pathway through (a) Growth in Renewables & (b) Increase in Gas usage

Renewables

Morocco's Paris Agreement NDC target calls for an increase of **renewable** energies in the **electricity mix** to 52 % by 2030. This target was recently increased to reach **more than 52 %** by 2030 (https://www.trade.gov/country-commercial-guides/morocco-energy).

Total installed capacity of renewable energies stands at 4 GW, or ~38% of installed electrical capacity. The National Office of Electricity & Water (ONEE) is targeting an installed electrical capacity of **10 GW** from renewables by **2030**, with 4.5 GW from solar, 4.1 GW from wind and 1.3 GW from hydropower. This growth is aided by enhanced legislative and **regulatory frameworks** governing renewable energy projects by the **private sector** and various amendments in existing laws on renewable energy, self-production of electrical energy, and electricity sector regulation. Notable projects include Noor complex solar power plants (operating since 2016); the Ain Beni Mathar and the Tarfaya wind farms (operational since 2009 and 2014, respectively); and the Abdelmoumen hydroelectric plant.

Natural Gas

Natural Gas, which is a cleaner hydrocarbon compared to coal, is seeing an increased share in the energy mix and is targeted to completely replace the coal-fired plants by 2050. In August 2021, the Moroccan Ministry of Energy, Mines, and the Environment announced a new **National Roadmap for the Development of Natural Gas 2021-2050** (https://www.mem.gov.ma/Lists/Lst_rapports/Attachments/27/Feuille%20de%20route%20du%20gaz%20naturel%20au%20Maroc%20.pdf). The roadmap lays the groundwork for the development of natural gas for industrial needs initially, followed by domestic needs, while continuing its development to integrate electricity generation needs.

Morocco plans to launch a tender to build a **floating liquefied natural gas (LNG) terminal** in the northeastern Nador West Med Port. The financial close is expected in 2025 with

commercial operations due in 2026. Morocco's natural gas needs are expected to rise to 8 bcm in 2027 from 1 bcm currently. (https://www.reuters.com/markets/commodities/morocco-tender-floating-lng-terminal-official-says-2024-05-31/#:~:text=Morocco%20plans%20to%20launch%20a%20tender%20this,terminal%20in%20the%20northeastern%20Nador%20West%20Med)

Hydrogen Economy & P-to-X

Due to its high renewable energy potential, Morocco aspires to be a global leader in the industrial **production**, **domestic consumption**, and **export** of green hydrogen and **ammonia**. It is the first country in the MENA region to adopt a **Green Hydrogen Roadmap**, which it unveiled in 2021 (https://www.mem.gov.ma/Lists/Lst_rapports/Attachments/36/Feuille%20de%20route%20de%20hydrog%C3%A8ne%20vert.pdf):

(a) Short term (2020-2030): the focus is on (i) exports and (ii) the use of GH_2 as an industry feedstock
(b) Medium term (2030-2040): the focus will be on using GH_2 (i) as an energy storage vector to ensure grid stability, but also (ii) in public and heavy trucks transports.
(c) Long term 2040-2050: the strategy foresees higher levels of (i) exports and use in (ii) industrial heat, (iii) railway, **maritime,** and aviation transport, as well as passenger vehicles.

The strategy has a goal to install **14.6 GW** of **extra renewable** energy capacity through **2030** and 131.5 GW through 2050, outside of the electricity sector (currently around 10 GW), as well as an overall CAPEX to expand the green hydrogen sector in the country that may exceed $100 billion by 2050.

Morocco has now announced an operational and incentive offer with a simplified investor pathway (https://www.masen.ma/en/green-hydrogen-moroccan-offer).

A **$27.2 billion** investment in GH_2 was announced in the Dakhla-Oued Ed-Dahab region. If the necessary renewable energy infrastructure is available, Morocco could produce **1.2 million tons** of GH_2 annually by **2030** (about 4–5 % of projected global demand) and **2.7 million tons** annually by **2040**.

Morocco's state-owned OCP Group announced that, through a JV with Fortescue of Australia, it will build green Ammonia Project near Tarfaya in Morocco's south. The plant will produce 200,000 tonnes of ammonia from 2026 with capacity expansion plans of 1 million tonnes and 3 million tonnes by 2027 and 2032 respectively. It will be powered with 1.2 GW of solar and 2.6 GW of wind energy, and desalinated water will be used for electrolysis. (https://ammoniaenergy.org/articles/ocp-group-renewable-ammonia-production-facility-planned-for-southern-morocco/)

2. National Action Plan on Maritime Decarbonization ("NAP")

Morocco has been working to develop its NAP, which was supported by the IMO GloMEEP project. At the time of this report, a formal document on Morocco's NAP is not available in the public domain. Notwithstanding this, following three key focus areas might prominently feature in the country's NAP, viz. (a) Decarbonization of Ports & Terminals, (b) Development of Bunkering Hub for Green Ammonia and (c) Development of Green Shipping Corridors, which are already featuring in practice in Morocco's maritime decarbonization efforts and which are briefly described here.

Green Ports in Morocco

In January 2024, the Minister of Equipment has announced a new national strategic vision for the port sector (https://www.anp.org.ma/en/publications/strategieportuaire) through a "green transition plan" for Moroccan ports. This is agreed with the port authorities and covering five strategic areas: water and energy efficiency, decarbonisation, resilience to climate change, protection of the port and marine environment, and sustainable mobility.

The Moroccan port landscape will be shaped by three pillars supporting this proactive green transition policy:

1. The port as a facilitator of the national energy transition
2. The port as an accelerator of maritime transport decarbonization
3. The port as a modern, smart, and green industrial hub

As part of the new measures taken to speed up decarbonization, ports will be required to promote clean maritime transport by:

- Providing bunker fuels sourced from energy with zero or near-zero GHG emissions
- Supplying shore power to ships from renewable energy sources, especially for cruise ships and container vessels
- Improving the efficiency of the supply chain to optimize operations, reduce waiting times, and minimize unnecessary ship movements

Morocco has taken steps to reduce energy consumption through LED lighting and intelligent power management. (https://wwwcdn.imo.org/localresources/en/About/Events/Documents/Presentations%20-%20Green%20Shipping%20Conference/8.%20Safae%20-%20Pre%CC%81sentation%20ACCRA%20Green%20shipping%20V4.pdf) Through improvements in processes, e.g. better flow of trucks and just in time arrival of ships, it is reducing the energy consumption of port users. It is installing PV cells on port buildings to harness solar power.

Casablanca Port is studying the feasibility of supplying shore power to cruise ships at the port. Its container ports are to follow suit.

Development of Bunkering Hub of Green Fuels

Morocco is endowed with excellent renewable potential, for solar and wind. Its plans for renewables' share in the electricity energy mix to be more than 52% by 2030, is considered to be adequate for its climate action. Also, from 2017, the entire population of the country has access to electricity. Thus, maximizing the renewables' potential beyond the electricity

generation, and developing P-to-X projects which can generate employment and produce economic benefits, may become an attractive policy choice.

For P-to-X, why should green ammonia be chosen? The main industry in Morocco is the mining and processing of phosphate rock. These activities are not typically large emitters, and hence there is low potential for capturing industrial emissions for use as carbon feedstock.

On the other hand, as demand grows for green fuels for shipping, bunkering green fuels at Morocco could be a viable strategy for the majority of containerships to increase their operational autonomy when sailing between Western Europe and East Asia (https://www.transportenvironment.org/uploads/files/Europe-Asia-Green-Corridors-Case-for-Morocco-as-a-shipping-green-H2-hub_TE-Imal.pdf).

Morocco aims to become a major hub for the export and bunkering of alternative fuels. The country seeks to facilitate the development of alternative bunker fuel supply chains by leveraging the competitive strength and potential of its key ports' strategic locations, while progressively integrating green hydrogen production infrastructure within the country.

Additionally, the "Morocco Climate and Development Report" (CCDR), published by the World Bank in November 2022 (https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099655011022211130/p1773760faedc508c08f8c036570ce9c659), highlights that Morocco could benefit from large-scale production of green hydrogen and its derivatives. These could be used domestically for producing green fertilizers, storing renewable electricity, serving as a substitute for natural gas, and powering transportation, including maritime transport.

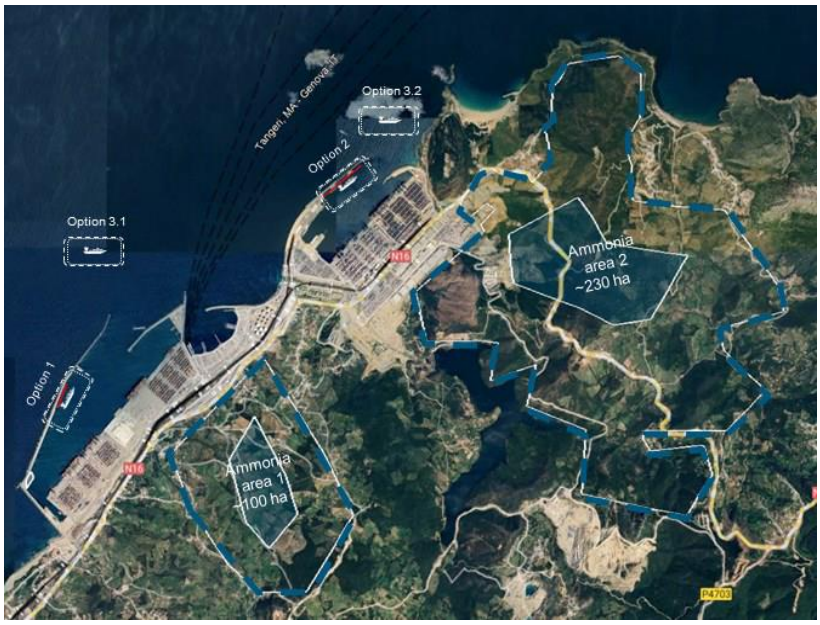


Figure 4: Spatial Overview of Tanger Med Port for production & bunkering of e-fuels

Source: Report by Royal HaskoningDHV

The Ministry of Equipment and Water, in collaboration with port authorities, has conducted pre-feasibility studies on the production, storage, supply, and export of carbon-free bunker fuel in Morocco. These studies aim to supply ships at Moroccan ports with green bunker fuels. The studies cover **Tanger Med Port**, Mohammedia Port, Jorf Lasfar Port, Nador West Med Port, and Dakhla Port.

Pilot Projects

Two pilot projects have been identified.

The Tanger Med pilot project focuses on exploring the feasibility of ship-to-ship bunkering with alternative fuels. The goal of this project is to gain experience in operational procedures and regulations related to methanol and ammonia.

Development of Green Shipping Corridors ("GSC")

Morocco is one of the initial signatory countries of the **Clydebank Declaration** where signatories pledge to consider the inclusion of GSC in the NAPs (https://www.gov.uk/government/publications/cop-26-clydebank-declaration-for-green-shipping-corridors/cop-26-clydebank-declaration-for-green-shipping-corridors). Thus, GSC development is likely to feature in its NAP.

Its container ports on the Mediterranean coast fall in the main Europe East Asia container trade lane. Morocco may consider leveraging "**WESTMED blue economy initiative**" and collaborating with suitable stakeholders, including shipping lines, to study the feasibility of a GSC project.

LATIN AMERICA CASE STUDY: CHILE

1. Country Climate Policy & Energy Transition Objectives

Chile has made important climate commitments (https://www.elibrary.imf.org/downloadpdf/journals/002/2023/037/article-A003-en.xml), such as updating in 2020 its Nationally Determined Contribution (**NDC**) target to **reduce CO_2** emissions by up to **45 % by 2030** from 2016 levels and reach **carbon neutrality before 2050**. As part of its climate strategy, Chile, in 2014, introduced a **US$5 tax** per ton of CO_2, making it the first Latin American country to introduce green taxes on CO_2 emissions and local pollutants. The new president in 2021 proposed a 'Green Tax Reform' including a gradual increase of the carbon tax up to **US$ 40** per ton of CO_2, but no timeframe was specified (https://www.iea.org/policies/19279-law-20780-on-incorporating-tax-measures-chile-carbon-tax). Chile was a pioneer in green financing, becoming the first country in the region to issue **green bonds** in 2019, and in the same year announcing the **decommissioning of coal-fired power plants by 2040**.

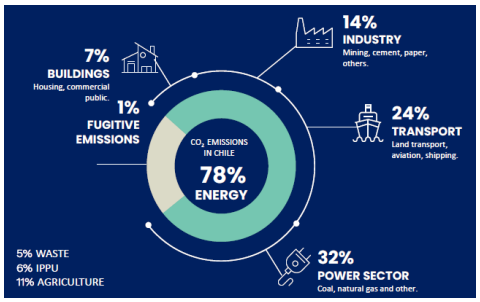


Figure 1: Chile's GHG Emission by Sector

Chile's **energy use** accounts for **three-quarters** of total emissions. Electricity generation and transport account for the two largest shares. Coal and diesel are the two fuels emitting the most (coal for electricity generation in power plants and diesel for transport). Additionally, Chile imports nearly **98% of** the fossil fuels it uses, leaving the country in a vulnerable position, both in terms of supply security and fluctuating international fuel prices.

Figure 2: Chile's Energy Mix (2022)

64% of the energy used in the country was supplied by fossil sources, such as diesel, gasoline, natural gas, among others. 14% of the energy corresponds to biomass. **22%** of the total energy was supplied by electricity. Of this, **55%** came from **renewables**.

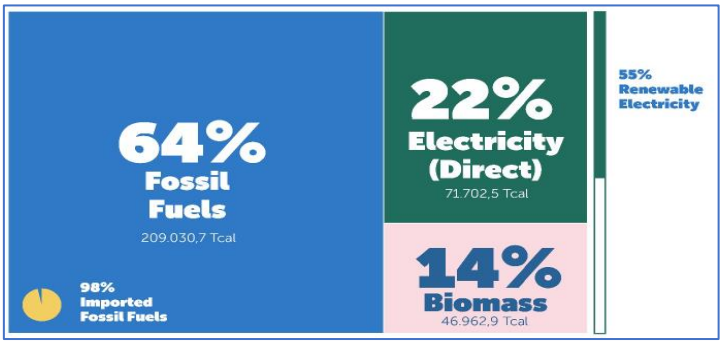
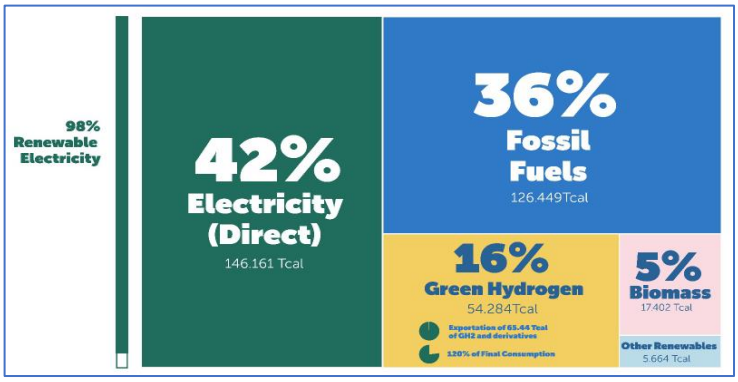


Figure 3: Chile's Energy Mix (2050)



The reduction in fossil fuel consumption, driven by increased electrification of consumption, shifting from 22% to about 42% by 2050, and the incorporation of green H_2 & its derivatives, accounting for about **16%** of national energy consumption. **98%** of **electricity** is to come from the **renewable sources**.

Hydrogen

Chile possesses unique comparative advantages in this area. The winds in southern Chile and solar radiation in the Atacama Desert surpass those of anywhere else in the world, providing ideal conditions for energy generation through wind and solar plants that cannot be replicated elsewhere (https://energia.gob.cl/sites/default/files/national_green_hydrogen_strategy_-_chile.pdf).

Chile has an **immensely powerful triad**: **copper, lithium, and green hydrogen**. With green hydrogen, it has a unique opportunity to innovate, to provide the necessary incentives, and thus prepare and facilitate the creation of an industry for the future. Chile's Hydrogen Strategy explains the country's ambition and its **Green Hydrogen Action Plan 2023-2030** (https://energia.gob.cl/sites/default/files/documentos/green-hydrogen_action-plan.pdf) further more specifies concrete actions that will be carried out in the maritime sector.

The Green Hydrogen Strategy, which arises from other strategies that address the fight against the effects of climate change, along wiht the Climate Change Law, the long-term Climate Strategy term, envisages that **opportunities will unveil in three distinct waves**. The **first wave** is to include **domestic usage** with existing large energy or hydrogen demand**.** The shorter-term opportunities are replacing imported ammonia for local production, and replacing grey hydrogen used in oil refineries. The use of green hydrogen for heavy and long-distance transportation also becomes attractive for fleets and machinery operating in concentrated zones. The start of export activities and extended local uses will be seen before the decade is over. **A clear opportunity for green ammonia exports exists in the medium-term**, as well as for the first hydrogen exports. A more competitive production of green hydrogen will also replace an increasing share of liquid fuels in land transportation, whereas blending into grids becomes economical. New **export markets open in the long-term**, enabling a massive scale-up of production. Fuels derived from green hydrogen will be key to **decarbonize the shipping** & aviation sectors, both **in domestic and international routes**. Export markets will continue to grow as other nations take action.

The example of Chile also showcases the importance of strong participation of the maritime industry in territorial and infrastructure adaptation and planning, in the creation of

technological development centres, ast addressed by the Chilean Navy, and in the green corridors, indicated further bellow.

HyEx: the Green Ammonia project in Chile with implications for the Maritime Industry

Enaex Chile is the largest manufacturer & distributor of mining explosives in Latin America. It imports approximately 350,000 tons of ammonia per year for conversion to ammonium nitrate blasting agents at its Prillex plant in Mejillones. The company aims to decarbonize its value chain.. In Phase 1 (2025), it plans to produce 18,000 tons of green ammonia by using green hydrogen produced by its partner ENGIE from a 26 MW electrolysis plant. In Phase 2 (2030), at full-scale, the HyEx is estimated to be based on 2.8 GWp of newbuild solar PV capacity to power 2.0 GW of electrolyser capacity in the Atacama desert. The ammonia plant is located downstream in Mejillones, and will be connected to the hydrogen plant via pipeline. About half of the 700,000 ton per year production will be used in Enaex's existing requirements, while the balance may serve ammonia energy uses such as mobility or export to global markets. This allows the **ammonia import hub of Mejillones to potentially become an ammonia export hub in the future** (https://ammoniaenergy.org/articles/hyex-ammonia-from-the-chilean-desert/).

Other relevant project includes the Volta Project, "From Chile to the world, innovation in green hydrogen and green ammonia to address decarbonization": https://mae-energy.com/proyecto-volta/

General Strategy of the Chilean Maritime Administration

According to the General Strategy (https://www.directemar.cl/directemar/site/docs/20230517/20230517092433/strategy.pdf), the mission is to achieve the effective implementation of the international instruments of the International Maritime Organization, and to meet the highest performance standards in the maritime & port sector.

Green Shipping Corridors

In November 2021, the country was among the first to sign the **Clydebank Declaration** to support the establishment of green shipping corridors. The **Chilean Green Corridors Network** was announced in 2002 at the "**Our Ocean Conference**" hosted by the governments of the Republic of **Palau** and the United States. It is a collaboration between the Chilean government and the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping to establish green shipping routes in and out of Chile, establishing collaboration between private and public sector The work is carried out in phases (https://www.zerocarbonshipping.com/projects/chilean-green-corridors-network-project-2/):

- Phase 1 **Prefeasibility**: Identify and shortlist routes for further analysis. This phase is complete and it identified eighteen distinct corridors, out of which seven are domestic and the balance are international ones. The study revealed that most of the energy projects in

Chile would be producing ammonia, and thus an absence of e-methanol in the alternative fuel mix.

- Phase 2 **Feasibility**: Perform a technical, regulatory and commercial feasibility analysis on the shortlisted routes. The steps include consortium construction within each of the selected corridors and signing of Memorandum of Understanding.
- Phase 3 **Deployment**: Investigate the implementation of selected corridors and establish zero emission shipping routes between the involved ports.

Additionally, the **Green Hydrogen Action Plan 2023-2030** lists the following as an action item:

- the publication of feasibility results for the **transportation of copper and sulphuric acid** to materialise the first **green commercial maritime route in Latin America before 2030**, prioritising the Antofagasta Region and other industrial zones of the country.